# TOWN OF IPSWICH
# HAZARD MITIGATION PLAN
# DRAFT 2018 UPDATE

**Draft Plan Update**
***December 3, 2018***

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**TOWN OF IPSWICH HAZARD MITIGATION PLAN**
**DRAFT 2018 UPDATE**

## *ACKNOWLEDGEMENTS AND CREDITS*

This plan was prepared for the Town of Ipswich by the Metropolitan Area Planning Council (MAPC) under the direction of the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation (DCR). The plan was funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation (PDM) Grant Program.

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**TOWN OF IPSWICH HAZARD MITIGATION PLAN**
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# I. EXECUTIVE SUMMARY

Hazard Mitigation planning is a proactive effort to identify actions that can be taken to reduce the dangers to life and property from natural hazard events. In the communities of the Boston region of Massachusetts, hazard mitigation planning tends to focus most on flooding, the most likely natural hazard to impact these communities. The Federal Disaster Mitigation Act of 2000 requires all municipalities that wish to be eligible to receive FEMA funding for hazard mitigation grants, to adopt a local multi-hazard mitigation plan and update this plan in five year intervals.

## Planning Process

This is an update of the original Ipswich Hazard Mitigation Plan, which was adopted by the Town of Ipswich on June 4, 2012. Planning for the Hazard Mitigation Plan update was led by the Ipswich Local Hazard Mitigation Planning Team, composed of staff from six Town Departments (see Table 3). The team met on November 27, 2017, March 29, 2018, and July 18, 2018 and discussed where the impacts of natural hazards most affect the Town, goals for addressing these impacts, updates to the Town's existing mitigation measures and new or revised hazard mitigation measures that would benefit the Town.

Public participation in this planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the Town takes to mitigate them. The Town's Planning Board hosted the first public meeting on March 29, 2018 and the second was hosted by the Select Board on December3, 2018, and the draft plan update was posted on the Town's website for public review. Key Town stakeholders and neighboring communities were notified and invited to review the draft plan and submit comments. See list of outreach contacts and press releases in Appendix C.

## Risk Assessment

The Ipswich Hazard Mitigation Plan assesses the potential impacts to the Town from flooding, high winds, winter storms, coastal hazards, brush fire, geologic hazards, extreme temperatures, and drought. Flooding, driven by hurricanes, northeasters and other storms, clearly presents the greatest hazard to the Town. These are shown on the map series (Appendix B).

The Ipswich Local Hazard Mitigation Planning Team identified 93 Critical Facilities. These are also shown on the map series and listed in Table 20, identifying which facilities are located within the mapped hazard zones.

A HAZUS-MH analysis provided estimates of damages from Hurricanes of category 2 and 4 ($10.6 million to $48.5 million) as well as earthquakes of magnitudes 5 and 7 ($365.7 million to $2,266.6 million). Flood damage estimates range from $39.7 million for a 100-year storm to $84.5 million for a 500-year storm.

The Ipswich Local Hazard Mitigation Planning Team identified the following hazard mitigation goals for the Town:

1. Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all major natural hazards.

2. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.

3. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.

4. Prevent and reduce the damage to public infrastructure resulting from all hazards.

5. Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.

6. Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

7. Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.

8. Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.

9. Consider the impacts of climate change and incorporate climate mitigation and adaptation in hazard mitigation planning.

**Hazard Mitigation Strategy**

The Ipswich Local Hazard Mitigation Planning Team identified a number of mitigation measures that would serve to reduce the Town's vulnerability to natural hazard events. These include numerous infrastructure and drainage upgrades, which are detailed in Table 34.

Overall, the hazard mitigation strategy recognizes that mitigating hazards for Ipswich will be an ongoing process as our understanding of natural hazards and the steps that can be taken to mitigate their damages changes over time. Global climate change and a variety of other factors impact the Town's vulnerability and in the future. Local officials will need to work together across municipal lines and with state and federal agencies in order

to understand and address these changes. The Hazard Mitigation Strategy will be incorporated into the Town's other related plans and policies.

**Plan Review and Update Process**

The elements of the plan review and update process are summarized in Table 1.

**Table 1 Plan Review and Update**

| Chapter | Reviews and Updates |
|---|---|
| III – Public Participation | The Local Hazard Mitigation Planning Team placed an emphasis on public participation for the update of the Hazard Mitigation Plan, discussing strategies to enhance participation opportunities at the first local committee meeting. During plan development, the plan was discussed at two public meetings hosted by the Planning Board and the Select Board. The plan was also available on the Town's website for public comment. |
| IV – Risk Assessment | MAPC gathered the most recently available hazard and land use data and met with Town staff to identify changes in local hazard areas and development trends. Town staff reviewed critical infrastructure with MAPC staff in order to create an up-to-date list. MAPC also used the most recently available version of HAZUS and assessed the potential impacts of flooding using the latest data. |
| V - Goals | The Hazard Mitigation Goals were reviewed and endorsed by the Ipswich Local Hazard Mitigation Planning Team. |
| VI – Existing Mitigation Measures | The list of existing mitigation measures was updated to reflect current mitigation activities in the Town. |
| VII & VIII – Hazard Mitigation Strategy | Mitigation measures from the 2012 plan were reviewed and assessed as to whether they were completed, in-progress, or deferred. The Local Hazard Mitigation Planning Team determined whether to carry forward measures into the 2018 Plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2012 plan. The Local Hazard Mitigation Team prioritized all of these measures based on current conditions. |
| IX – Plan Adoption & Maintenance | This section of the plan was updated with a new on-going plan implementation review and five year update process that will assist the Town in incorporating hazard mitigation issues into other Town planning and regulatory review processes and better prepare the Town for the next comprehensive plan update. |

As indicated on Table 32, Ipswich made progress on implementing mitigation measures identified in the 2012 Hazard Mitigation Plan. Several projects have been completed, including

- 187 County Road-- Elevated low-lying road section
- Old Right Road-- Replace culvert and elevate low section in road
- Drainage Infrastructure-- Increased municipal drainage preventive maintenance practices
- Drainage Infrastructure-- Increase manpower available to DPW and Fire Departments prior to and during flooding emergencies.
- Upgraded all fire road emergency access gates and install a universal key system
- Incorporated outfalls and catch basins into GIS database

Several other projects were partially completed. These will be continued in this 2018 Plan Update.

Moving forward into the next five year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision making processes.

Though not formally done in the 2012 Plan, the Town will document any actions taken within this iteration of the Hazard Mitigation Plan on challenges met and actions successfully adopted as part of the ongoing plan maintenance to be conducted by the Ipswich Hazard Mitigation Implementation Team, as described in Section IX, Plan Adoption and Maintenance.

# II. INTRODUCTION

## Planning Requirements under the Federal Disaster Mitigation Act

The Federal Disaster Mitigation Act, passed in 2000, requires that after November 1 2004, all municipalities that wish to continue to be eligible to receive FEMA funding for hazard mitigation grants, must adopt a local multi-hazard mitigation plan and update this plan in five year intervals. This planning requirement does not affect disaster assistance funding.

Federal hazard mitigation planning and grant programs are administered by the Federal Emergency Management Agency (FEMA) in collaboration with the states. These programs are administered in Massachusetts by the Massachusetts Emergency Management Agency (MEMA) in partnership with the Department of Conservation and Recreation (DCR).

The Metropolitan Area Planning Council (MAPC) subcontracted with the Town of Ipswich to update its local Hazard Mitigation Plans, which was first adopted in 2012. The local Hazard Mitigation Plan update produced under this grant is designed to individually meet the requirements of the Disaster Mitigation Act for each community while listing regional concerns and hazards that impact the Town or City creating the plan.

## What is a Hazard Mitigation Plan?

Natural hazard mitigation planning is the process of determining how to systematically reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes. Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries, and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects, and other activities.

## Previous Federal/State Disasters

Essex County, which includes the Town of Ipswich, has experienced 22 natural hazards that triggered federal or state disaster declarations since 1991. These are listed in Table 2 below. The majority of these events involved flooding, while five were due to hurricanes or nor'easters, and four were due to severe winter weather.

**Table 2 Previous Federal/State Disaster Declarations**

| DISASTER NAME (DATE OF EVENT) | TYPE OF ASSISTANCE | DECLARED AREAS |
|---|---|---|
| Hurricane Bob (August 1991) | FEMA Public Assistance Project Grants | Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk |
| | Hazard Mitigation Grant Program | Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (16 projects) |
| No-Name Storm (October 1991) | FEMA Public Assistance Project Grants | Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk |
| | FEMA Individual Household Program | Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk |
| | Hazard Mitigation Grant Program | Counties of Barnstable, Bristol, Dukes, Essex, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk (10 projects) |
| March Blizzard (March 1993) | FEMA Public Assistance Project Grants | All 14 Counties |
| January Blizzard (January 1996) | FEMA Public Assistance Project Grants | All 14 Counties |
| May Windstorm (May 1996) | State Public Assistance Project Grants | Counties of Plymouth, Norfolk, Bristol |
| October Flood (October 1996) | FEMA Public Assistance Project Grants | Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk |
| | FEMA Individual Household Program | Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk |
| | Hazard Mitigation Grant Program | Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk (36 projects) |

| DISASTER NAME (DATE OF EVENT) | TYPE OF ASSISTANCE | DECLARED AREAS |
|---|---|---|
| 1997 | Community Development Block Grant-HUD | Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk |
| June Flood (June 1998) | FEMA Individual Household Program | Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester |
| | Hazard Mitigation Grant Program | Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (19 projects) |
| (1998)` | Community Development Block Grant-HUD | Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester |
| March Flood (March 2001) | FEMA Individual Household Program | Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester |
| | Hazard Mitigation Grant Program | Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester (16 projects) |
| February Snowstorm (Feb 17-18, 2003) | FEMA Public Assistance Project Grants | All 14 Counties |
| January Blizzard (January 22-23, 2005) | FEMA Public Assistance Project Grants | All 14 Counties |
| Hurricane Katrina (August 29, 2005) | FEMA Public Assistance Project Grants | All 14 Counties |
| May Rainstorm/Flood (May 12-23, 2006) | Hazard Mitigation Grant Program | Statewide |
| April Nor'easter (April 15-27, 2007) | zard Mitigation Grant Program | Statewide |
| Flooding (March, 2010) | FEMA Public Assistance FEMA Individuals and Households Program SBA Loan | Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester |
| | Hazard Mitigation Grant Program | Statewide |

| DISASTER NAME (DATE OF EVENT) | TYPE OF ASSISTANCE | DECLARED AREAS |
|---|---|---|
| Tropical Storm Irene (August 27-28, 2011) | FEMA Public Assistance | Statewide |
| Hurricane Sandy (October 27-30, 2012) | FEMA Public Assistance | Statewide |
| Severe snowstorm and Flooding (February 8-09, 2013 | FEMA Public Assistance; Hazard Mitigation Grant Program | Statewide |
| Blizzard of 2015 (January 26-28, 2015) | FEMA Public Assistance; Hazard Mitigation Grant Program | Statewide |
| Severe Winter Storm (March 2-3, 2018) | FEMA Public Assistance; Hazard Mitigation Grant Program | Essex, Suffolk, Norfolk, Bristol, Plymouth, Barnstable Counties |
| Severe Winter Storm (March 13-14, 2018) | FEMA Public Assistance; Hazard Mitigation Grant Program | Essex, Suffolk, Norfolk, Worcester Counties |

(Source: database provided by MEMA)

**FEMA Funded Mitigation Projects**

The Town of Ipswich has received funding from FEMA for one mitigation project under the Hazard Mitigation Grant Program (HMGP).

| Project # | Project Title | Scope of Work | Total Project Cost (100%) | Federal Funding (75%) | Local Funding (25%) | Project Status |
|---|---|---|---|---|---|---|
| HMGP 4110-18 | Jeffrey's Neck Flood Mitigation Project | Phased project to include engineering and raising the existing roadway and associated driveways to address sea level rise | $1,206,387 | $904,790 | $301,597 | Ongoing |

## Community Profile

Once a thriving mill town, Ipswich today is a culturally and economically diverse community of over 13,000 persons, many of whom are descendants of Greek, Polish, Irish and English factory workers. There are summer communities located on Great Neck, Little Neck and Argilla Road, mixed with year-round residences. The town has a rich and varied history and is distinguished by a large number of 17th and early 18th century homes.

Ipswich's growth as a suburban town occurred during the 1950's and many residents commute to Boston by train and automobile. Among the town's attractions are Crane Beach, Castle Hill, extensive salt marshes, the Ipswich River, shell fishing and other waterfront activities.

Two state forests and parks, three large tracts owned by religious orders and several large farms and estates in open space restrictive covenants provide a rural character to sections of the community. There are 12 churches representing a wide array of different faiths and numerous active social, civic and fraternal organizations.

The Town is governed by a Select Board (formerly Board of Selectmen) with a Town Manager. The town operates under the open town meeting format. The population is 13,670 and there were 6,048 housing units in town. The Town's demographic characteristics are summarized in Table 3.

The town maintains a website at http://www. ipswichma.gov

Demographic characteristics in Ipswich that should be taken into consideration when planning for natural hazards are summarized in Table 3:

**Table 3: Ipswich Characteristics**

Population = 13,682

- 4.4% are under age 5
- 21.1% are under age 18
- 17.8% are over age 65
- 12.5% have a disability

Number of Housing Units = 6048

- 25.7% are renter-occupied housing units
- 29.7% of housing units were built before 1940

Source: U.S. Census, 2010 and American Community Survey 2016.

The Town of Ipswich has several unique characteristics to keep in mind while planning for natural hazards:

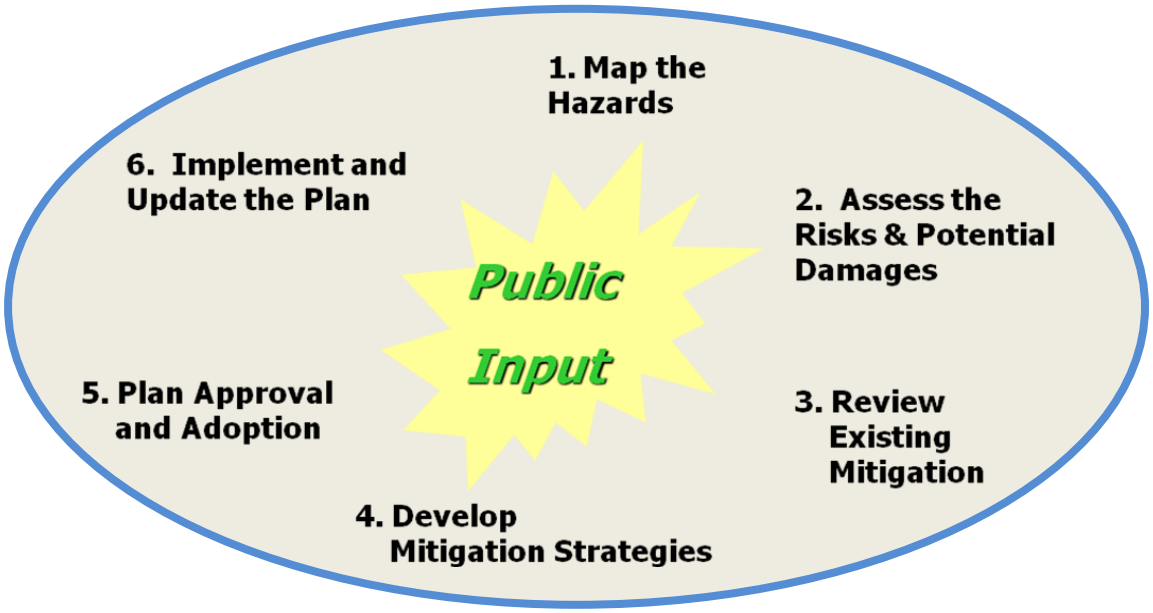
- A defining characteristic of Ipswich is that it is located at the mouth of the Ipswich River, which is the major watershed for the North Shore, encompassing part or all of 22 communities upstream from Ipswich.
- Ipswich is a coastal community, featuring Cranes Beach, one of the state's most popular beaches, as well as extensive coastal wetlands that are part of the "Great Marsh" that also extends to the towns of Essex, Rowley, Newbury, and Newburyport.
- Ipswich has one of the region's most significant shellfish industries, with 930,500 pounds of landings in 2016, valued at $1,775,000
- Ipswich's drinking water supply lies entirely within the town, so flood and stormwater management as well as smart growth development are critical to prevent contamination with flooding and prevent quantity issues with drought.
- The town has its own municipal Electric Light Department which manages distribution lines throughout the town.
- The town has proactive municipal officials that frequently share information and coordinate on a regular basis. An example of this is the town's Local Hazard Mitigation Team, which benefited from the participation of six municipal departments.
- Ipswich is home to historic structures and sites that are irreplaceable and bring economic value to the town.
- Ipswich contains several major roadways, most notably State Routes 1, 1A, and 133, which provide emergency routes for evacuation and access to medical facilities.
- Ipswich would be a good potential candidate for flood-related mitigation grants due to the potential impact to property, transportation routes, economic/historic resources, and the ability to solve the flooding problems through structural measures such as culvert upgrades, dam and bridge upgrades or flood proofing.
- Much of the critical infrastructure in the town is located in clusters, much of it in or near the town center area.

# III. PLANNING PROCESS AND PUBLIC PARTICIPATION

MAPC employs a six step planning process based on FEMA's hazard mitigation planning guidance focusing on local needs and priorities but maintaining a regional perspective matched to the scale and nature of natural hazard events. Public participation is a central component of this process, providing critical information about the local occurrence of hazards while also serving as a means to build a base of support for hazard mitigation activities. MAPC supports participation by the general public and other plan stakeholders through Regional and Local Hazard Mitigation Planning Teams, two public meetings hosted by the local Hazard Mitigation Team, posting of the plan to the Town's website, and invitations sent to neighboring communities, Town boards and commissions, the local chamber of commerce, and other local or regional entities to review the plan and provide comment.

**Planning Process Summary**

The six-step planning process outlined below is based on the guidance provided by FEMA in the Local Multi-Hazard Mitigation Planning Guidance. Public participation is a central element of this process, which attempts to focus on local problem areas and identify needed mitigation measures based on where gaps occur in the existing mitigation efforts of the municipality. MAPC is also able to identify regional opportunities for collaboration and facilitate communication between communities. In plan updates, the process described below allows staff to bring the most recent hazard information into the plan, including new hazard occurrence data, changes to a municipality's existing mitigation measures, and progress made on actions identified in previous plans.



- Map the Hazards – MAPC relies on data from a number of different federal, state, and local sources in order to map the areas with the potential to experience natural hazards. This mapping represents a multi-hazard assessment of the municipality and is used as a set of base maps for the remainder of the planning process. A particularly important source of information is the knowledge drawn from local municipal staff on where natural hazard impacts have occurred, which is collected. These maps can be found in Appendix B.

- Assess the Risks & Potential Damages – Working with local staff, critical facilities, infrastructure, vulnerable populations, and other features are mapped and contrasted with the hazard data from the first step to identify those that might represent particular vulnerabilities to these hazards. Land use data and development trends are also incorporated into this analysis. In addition, MAPC develops estimates of the potential impacts of certain hazard events on the community. MAPC drew on the following resources to complete the plan:

    - Town of Ipswich, General Bylaws
    - Town of Ipswich Stormwater Bylaw
    - Town of Ipswich Wetland Bylaw
    - Town of Ipswich, Zoning Bylaw
    - Great Marsh Coastal Adaptation Plan 2017
    - Town of Ipswich Open Space and Recreation Plan, 2013
    - Massachusetts State Hazard Mitigation Plan, 2013
    - FEMA, Local Mitigation Plan Review Guide; October 1, 2011
    - FEMA, Flood Insurance Rate Maps for Essex County, MA, 2014
    - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data.
    - New England Seismic Network, Boston College Weston Observatory
    - NOAA National Centers for Environmental Information
    - Northeast States Emergency Consortium, http://www.nesec.org/
    - USGS, National Water Information System, http://nwis.waterdata.usgs.gov/usa/nwis
    - US Census, 2010 and 2016

- Review Existing Mitigation – Municipalities in the Boston Metropolitan Region have an active history in hazard mitigation as most have adopted flood plain zoning districts, wetlands protection programs, and other measures as well as enforcing the State building code, which has strong provisions related to hazard resistant building requirements. All current municipal mitigation measures must be documented.

- Develop Mitigation Strategies – MAPC works with the local municipal staff to identify new mitigation measures, utilizing information gathered from the hazard identification, vulnerability assessments, and the community's existing mitigation efforts to determine where additional work is necessary to reduce the potential

damages from hazard events. Additional information on the development of hazard mitigation strategies can be found in Chapter VII.

- Plan Approval & Adoption – Once a final draft of the plan is complete it is sent to MEMA for the state level review and, following that, to FEMA for approval. Typically, once FEMA has approved the plan the agency issues a conditional approval (Approval Pending Adoption), with the condition being adoption of the plan by the municipality. More information on plan adoption can be found in Chapter IX and documentation of plan adoption can be found in Appendix D.

- Implement & Update the Plan – Implementation is the final and most important part of any planning process. Hazard Mitigation Plans must also be updated on a five year basis making preparation for the next plan update an important on-going activity. Chapter IX includes more detailed information on plan implementation.

**The Local Multiple Hazard Community Planning Team**

MAPC worked with the local community representatives to organize a local Hazard Mitigation Planning Team for Ipswich. MAPC briefed the local representatives as to the desired composition of that team as well as the need for outreach to stakeholders such as the business community, civic organizations and citizens at large.

The Local Hazard Mitigation Planning Team is central to the planning process as it is the primary body tasked with developing a mitigation strategy for the community. The local team was tasked with working with MAPC to set plan goals, provide information on the hazards that impact the Town, existing mitigation measures, and helping to develop new mitigation measures for this plan update. The Local Hazard Mitigation Planning Team membership can be found in Table 3 below.

The Ipswich Planning Board, as well as the Ipswich Conservation Commission, are the primary entities responsible for regulating development in town. Feedback from the Planning Board and the Conservation Commission was assured through the participation on the Local Hazard Mitigation Planning Team of the Town Planner and the Conservation Administrator. The Planning Board hosted the first public meetings on the plan, in March 2018. In addition, MAPC, as the State designated regional planning authority for Ipswich, works with all agencies that that regulate infrastructure development in the region, including the listed municipal entities and state agencies such as MassDOT, DCR, and the Massachusetts Environmental Policy Act (MEPA) Office.

On November 27, 2018, MAPC facilitated the first meeting of the Ipswich Local Hazard Mitigation Team. The Team was coordinated by Lt. Jonathan Hubbard for the Town. The team reviewed the scope of the project and began to update local data on Critical Facilities, hazard Areas of Concern, and development trends since the last plan. The second meeting of the Team was held on March 29, 2018. The purpose of the meeting was to review and develop hazard mitigation goals, review the status of

mitigation measures identified in the 2012 hazard mitigation plan, identify new potential mitigation measures and to gather information on local hazard mitigation issues and sites or areas related to these. The meeting also covered measures to be carried forward from the previous plan.

At the third meeting on July 18, 2018, the Team developed that list of recommended mitigation measures for this 2018 plan update, and added costs, time frames for implementation, and potential funding sources. Finally, the Team prioritized the measures based on considerations of estimated costs, impacts, and benefits.

An additional meeting was held with Frank Ventimiglia from the Dept. of Public Works on October 4, 2018 to finalize data on the recommended mitigation measures

The following table lists the members of the Ipswich Local Hazard Mitigation team. The agendas for these meetings are included in Appendix A.

**Table 4**
**Membership of the Ipswich Hazard Mitigation Planning Team**

| Name | Representing |
|---|---|
| Jonathan Hubbard | Police/Emergency Management |
| Brian J. Blake | Ipswich School District |
| Andre Theriault | Fire Department |
| Bill Hodge | Facilities |
| Ethan Parsons | Planning |
| Frank Ventimiglia | Dept. of Public Works |
| Vicki Halmen | Water and Wastewater |
| Alicia Geilen | Conservation |
| Jon Blair | Electric Light |
| Teri Demers | Water and Wastewater |

**Public Meetings**

Public participation in the hazard mitigation planning process is important, both for plan development and for later implementation of the plan. Residents, business owners, and other community members are an excellent source for information on the historic and potential impacts of natural hazard events and particular vulnerabilities the community may face from these hazards. Their participation in this planning process also builds understanding of the concept of hazard mitigation, potentially creating support for mitigation actions taken in the future to implement the plan. To gather this information and educate residents on hazard mitigation, the Town hosted two public meetings, one during the planning process and one after a complete draft plan is available for review.

One of the best strategies for informing and involving local citizens is to include discussion of the hazard mitigation plan on the agenda of an existing municipal board or commission. With this strategy, the meeting receives widespread advertising and a

guaranteed audience of the board or commission members plus those members of the public who attend the meeting. These board and commission members represent an engaged audience that is informed and up to date on many of the issues that relate to hazard mitigation planning in the locality and will likely be involved in plan implementation, making them an important audience with which to build support for hazard mitigation measures. In addition, these meetings frequently receive press coverage, expanding the audience that has the opportunity to hear the presentation and provide comment.

The public had an opportunity to provide input to the Ipswich hazard mitigation planning process during a public meeting hosted by the Planning Board on March 29, 2018 in the Town Hall. The draft plan update was presented at a second public meeting hosted by the Select Board on December 3, 2018 in Town Hall. Both meetings were publicized as public meetings according to the Massachusetts Public Meeting Law. The attendance list for each meeting can be found in Table 4. See public meeting notices in Appendix C.

**Local Stakeholder Involvement**

The local Hazard Mitigation Planning Team was encouraged to reach out to local stakeholders that might have an interest in the Hazard Mitigation Plan including neighboring communities, agencies, businesses, nonprofits, and other interested parties. Notice was sent to the following organizations and neighboring municipalities inviting them to review the Hazard Mitigation Plan and submit comments to the Town: See list of outreach contacts and press releases in Appendix C.

Town of Essex
Town of Hamilton
Town of Rowley
Town of Topsfield
The Trustees of Reservations
Ipswich Chamber of Commerce
Ipswich River Watershed Association
Ipswich Rotary Club
Essex County National Heritage Area
Ipswich Museum
Friends of Parker River NWR
Essex County Greenbelt
Essex County National Heritage Area

**Town Web Site**

The draft Ipswich Hazard Mitigation Plan 2018 Update was posted on the Town's website following the second public meeting. Members of the public could access the draft document and submit comments or questions to the Town.

**Continuing Public Participation**

Following the adoption of the plan update, the planning team will continue to provide residents, businesses, and other stakeholders the opportunity to learn about the hazard mitigation planning process and to contribute information that will update the Town's understanding of local hazard. As updates and a review of the plan are conducted by the

Hazard Mitigation Implementation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with Town and state open meeting laws.

**Planning Timeline**

| | |
|---|---|
| November 27, 2017 | First meeting of the Ipswich Local Hazard Mitigation Planning Team |
| March 29, 2018 | First Public Meeting hosted by the Ipswich Planning Board |
| March 29, 2018 | Second meeting of the Local Hazard Mitigation Planning Team |
| July 18, 2018 | Third meeting of the Local Hazard Mitigation Planning Team |
| October 4, 2018 | Meeting with Ipswich Dept. of Public Works |
| December 3, 2018 | Second Public Meeting hosted by the Ipswich Select Board |

# IV. RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the Town of Ipswich as well as the relationship between those hazards and current land uses, potential future development, and critical infrastructure. This section also includes a vulnerability assessment that estimates the potential damages that could result from certain large scale natural hazard events.

**Update Process**

In order to update Ipswich's risk assessment, MAPC gathered the most recently available hazard and development data and met with Town's Local Hazard Mitigation Team to identify changes in local hazard areas and development trends. MAPC also used FEMA's damage estimation software, HAZUS (described below).

**Overview of Hazards and Impacts**

Previous state and federal disaster declarations since 1991 are summarized in Table 2. Table 5 below summarizes the hazard risks for Ipswich. This evaluation takes into account the frequency of the hazard, historical records, and variations in land use. This analysis is based on the vulnerability assessment in the Massachusetts State Hazard Mitigation Plan. The statewide assessment was modified to reflect local conditions in Ipswich using the definitions for hazard frequency and severity listed below. Based on this, the Town set an overall priority for each hazard.

**Table 5 - Hazard Risks Summary**

| Hazard | Frequency | | Severity | |
|---|---|---|---|---|
| | Massachusetts | Ipswich | Massachusetts | Ipswich |
| Flooding | High | High | Serious | Serious |
| Dam failures | Very Low | Very Low | Extensive | Serious |
| Hurricane/Tropical Storm | Medium | Medium | Serious | Serious |
| Tornadoes | Medium | Very Low | Serious | Serious |
| Thunderstorms | High | High | Minor | Minor |
| Nor'easter | High | High | Minor | Minor |
| Winter-Blizzard/Snow | High | High | Minor | Minor |
| Winter-Ice Storms | Medium | Medium | Minor | Minor |
| Earthquakes | Very Low | Very Low | Serious | Serious |
| Landslides | Low | Very Low | Minor | Minor |
| Brush fires | Medium | High | Minor | Minor |
| Extreme Temperatures | Medium | Medium | Minor | Minor |
| Drought | Low | Low | Minor | Minor |
| Coastal Hazards | High | High | Serious | Serious |
| Tsunami | Very Low | Extensive | Extensive | Extensive |

**Table 5 - Hazard Risks Summary**

| | | | | |
|---|---|---|---|---|
| Major Urban Fires | Low | N/A | Serious | N/A |
| Ice Jams | Low | N/A | Minor | N/A |

Source, Massachusetts State Hazard Mitigation Plan, 2013, modified for Ipswich

Note: Of the hazards listed in the Massachusetts State Hazard Mitigation Plan, several categories are not applicable to Ipswich: \

- Major Urban Fires, due to the lack of significant wildfire areas in close proximity to urban development that could pose a significant threat of urban fire.

- Ice Jams, due to the lack of a water body that is subject to ice jams in Ipswich. The US Army Corps of Engineers Ice Jam Database shows no recorded ice jams in the Town of Ipswich.

**Definitions used in the Commonwealth of Massachusetts State Hazard Mitigation Plan**

***Frequency***

**Very low frequency:** events that occur less frequently than once in 100 years (less than 1% per year)
**Low frequency:** events that occur from once in 50 years to once in 100 years (1% to 2% per year);
**Medium frequency:** events that occur from once in 5 years to once in 50 years (2% to 20% per year);
**High frequency**: events that occur more frequently than once in 5 years (Greater than 20% per year).

***Severity***

**Minor**: Limited and scattered property damage; limited damage to public infrastructure and essential services not interrupted; limited injuries or fatalities.
**Serious:** Scattered major property damage; some minor infrastructure damage; essential services are briefly interrupted; some injuries and/or fatalities.
**Extensive:** Widespread major property damage; major public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and/or fatalities.
**Catastrophic:** Property and public infrastructure destroyed; essential services stopped; numerous injuries and fatalities.

## Flood Related Hazards

Flooding was the most prevalent serious natural hazard identified by local officials in Ipswich. Flooding is generally caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms. Global climate change has the potential to exacerbate these issues over time with the potential for changing rainfall patterns leading to heavier storms.

Regionally Significant Floods

There have been a number of major floods that have affected the Metro Boston region over the last fifty years. Significant historic flood events have included:

- The Blizzard of 1978
- January 1979
- April 1987
- October 1991 ("The Perfect Storm") Considered to be a 100-year storm.
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- December 2010
- March 2013
- January 2018
- March 2018

Previous Flood Occurrences

The best available local data on previous occurrences of flooding are provided by NOAA's National Centers for Environmental Information for Essex County, which includes Ipswich. Essex County experienced 47 flood events from 1996 to 2018 (see Table 6). There were 2 deaths and 3 injuries reported and the total property damage in the county was $20.69 million dollars.

**Table 6 Essex County Flood Events, 1996--2018**

| Date | Deaths | Injuries | Property Damage $ |
|---|---|---|---|
| 10/22/1996 | 0 | 0 | 0.00K |
| 06/17/1998 | 0 | 0 | 0.00K |
| 06/18/1998 | 0 | 0 | 0.00K |
| 03/05/2001 | 0 | 0 | 0.00K |
| 04/03/2004 | 0 | 0 | 0.00K |

| Date | Deaths | Injuries | Property Damage $ |
|---|---|---|---|
| 10/15/2005 | 0 | 0 | 50.00K |
| 10/25/2005 | 0 | 0 | 45.00K |
| 05/13/2006 | 2 | 0 | 7.000M |
| 07/11/2006 | 0 | 0 | 10.00K |
| 07/28/2006 | 0 | 0 | 20.00K |
| 03/02/2007 | 0 | 0 | 20.00K |
| 04/16/2007 | 0 | 0 | 45.00K |
| 02/13/2008 | 0 | 0 | 30.00K |
| 03/08/2008 | 0 | 0 | 0.00K |
| 08/08/2008 | 0 | 0 | 25.00K |
| 09/06/2008 | 0 | 0 | 5.00K |
| 03/14/2010 | 0 | 1 | 9.800M |
| 03/30/2010 | 0 | 2 | 3.270M |
| 04/01/2010 | 0 | 0 | 0.00K |
| 08/05/2010 | 0 | 0 | 7.00K |
| 08/25/2010 | 0 | 0 | 0.00K |
| 10/04/2011 | 0 | 0 | 305.00K |
| 06/23/2012 | 0 | 0 | 0.00K |
| 08/10/2012 | 0 | 0 | 0.00K |
| 06/24/2013 | 0 | 0 | 5.00K |
| 07/01/2013 | 0 | 0 | 0.00K |
| 07/27/2014 | 0 | 0 | 0.00K |
| 10/23/2014 | 0 | 0 | 30.00K |
| 12/09/2014 | 0 | 0 | 0.00K |
| 08/18/2015 | 0 | 0 | 0.00K |
| 09/30/2015 | 0 | 0 | 0.00K |
| 06/29/2016 | 0 | 0 | 0.00K |
| 04/06/2017 | 0 | 0 | 0.00K |
| 06/27/2017 | 0 | 0 | 2.00K |
| 07/08/2017 | 0 | 0 | 0.00K |
| 07/18/2017 | 0 | 0 | 0.00K |
| 09/06/2017 | 0 | 0 | 0.00K |
| 09/15/2017 | 0 | 0 | 10.00K |
| 09/30/2017 | 0 | 0 | 4.00K |
| 10/25/2017 | 0 | 0 | 0.00K |
| 01/13/2018 | 0 | 0 | 5.00K |
| **TOTAL** | 2 | 3 | **20.69M** |

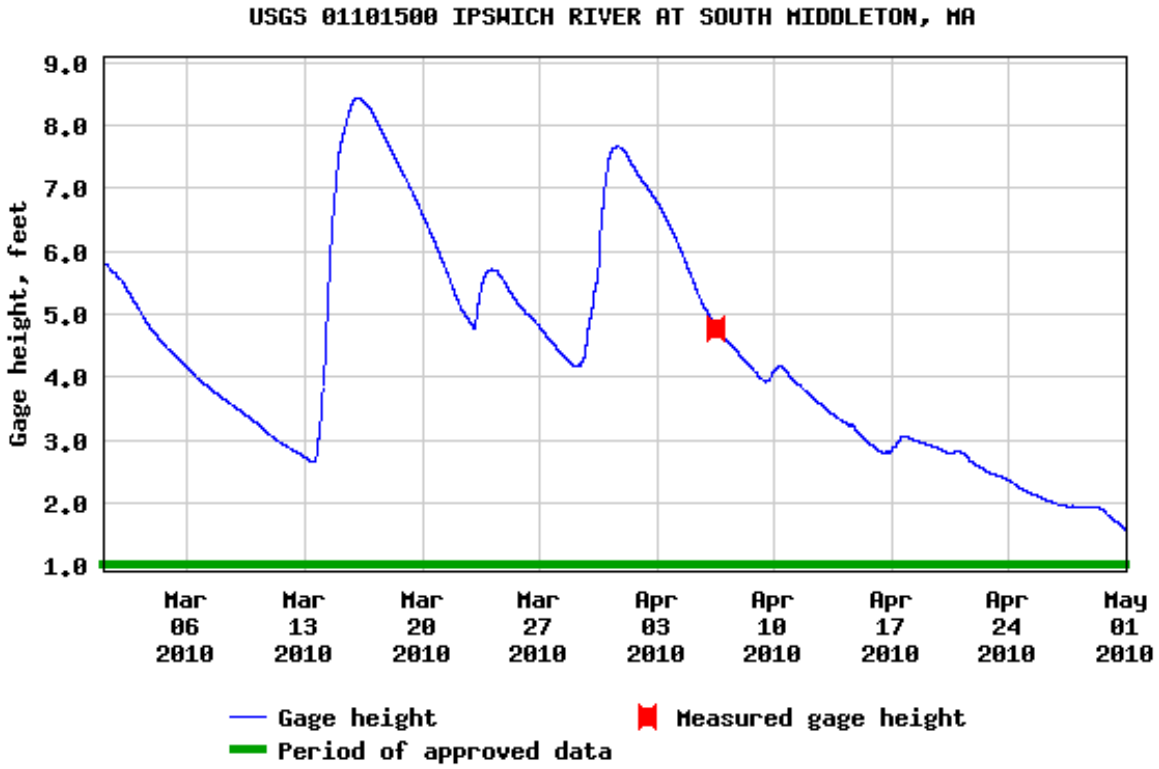
The most severe flooding since the previous plan occurred during March 2010, when a total of 14.83 inches of rainfall accumulation was recorded by the National Weather Service (NWS). The weather pattern that consisted of early springtime prevailing westerly winds that moved three successive storms, combined with tropical moisture from the Gulf of Mexico, across New England. Torrential rainfall caused March 2010 to be the wettest month on record.

One indication of the extent of flooding is the gage height at the nearest USGS streamflow gauging station, which is on the Ipswich River in South Middleton. The USGS gage height, shown in Figure 1, exceeded 8 feet on March 16, 2010 and exceeded 7.5 feet on March 31, 2010. Normal gage height in March is about 4 feet.

Of the total $20.69 million in flood damages recorded for Essex County from1996 to 2018, $13.1 million occurred during the March 2010 flooding (see Table 6). Another $7 million in damages was caused by the "Mother's Day" storm of May 2006.

Potential damages from flooding in the Town of Ipswich were estimated using FEMA's HAZUS-MH program. The results, shown in Table 30, indicate potential damages from a 1% Annual Chance Flood (100-year) at $39.7 million and from a 0.2% Annual Chance Flood (500-year) at $84.9 million.

**Figure 1- Ipswich River Gage Heights, March-April 2010**




Source, US Geological Service, National Water Information System

Overview of the Ipswich and Miles River Watershed and Flooding

River and stream flooding are the predominant source of potential flood waters in Ipswich. The Ipswich River watershed encompasses a 155 square-mile area, north of Boston, Massachusetts in Essex and Middlesex counties. The Ipswich River extends approximately 45 miles from its westernmost headwaters in the towns of Burlington and Wilmington, northeasterly to its mouth at Essex Bay and Plum Island Sound. The Ipswich River watershed includes all or portions of 22 towns, with Ipswich located in the most downstream section of the watershed where the river discharges into Ipswich Bay.

The river basin can be divided into three subsections: the upper, middle and lower watersheds. The upper watershed drains 44.5 square miles to South Middleton and has a mean annual stream flow of 41 million gallons per day (Mgd). The middle watershed drains 125 square miles, with a mean annual stream flow of 122 Mgd). The lower watershed, below the Willowdale Dam, includes another 30 square miles of drainage area to the Ipswich Dam and its flow is not measured by a stream flow gage. Below the Ipswich Dam the river becomes tidally-influenced. Approximately 20 tributaries feed into the Ipswich River. In the upper watershed, the larger tributaries include Maple Meadow Brook, Lubbers Brook and Martins Brook. In the middle watershed, tributaries include Norris, Emerson, Boston, Fish and Howlett Brooks. In the lower watershed, the Miles River is the largest tributary. A number of tributaries, as well as the Ipswich River itself, have dams that were built to store water, power mills and/or for recreation. Three dams continue to impound sections of the river, one in Middleton and two in Ipswich. Smaller dams and remnants can be found in the main stem and tributaries.

Historically, most flooding in Ipswich has taken place upstream of the town-owned Ipswich Mills Dam, located in the downtown Ipswich area. The presence of the Wenham Swamp in the upper reaches of the watershed has helped to absorb storm water and protect Ipswich from flooding. Over the last several decades development in the upper Ipswich River watershed has led to an increase in impervious surfaces. Stormwater that used to be absorbed by pervious ground and released slowly now runs off quickly, overwhelming stormwater storage capacity throughout the watershed and resulting in flooding events. Increased development has also led to an increase in siltation and vegetation within the watershed as soils and nutrients run off from impervious areas, further reducing the river's carrying capacity and floodwater storage. The Miles River, the largest tributary to the Ipswich River in the lower watershed, has been identified as an issue of Upper North Shore regional significance within this plan. Development and associated runoff, siltation, runoff, decreased stormwater storage capacity and increased invasive vegetation make the Miles River watershed a microcosm for the Ipswich River and contribute to its problems. Finally, precipitation events have increased in frequency and intensity over the last ten years, most likely the result of global warming trends. The Mother's Day flood of May 2006 and the March, 2010 flood both set historic records for peak water flows and caused extensive damage to homes, businesses, and bridges in Ipswich.

Potential Flood Hazard Areas

Information on flood hazard areas was taken from two sources. The first was the National Flood Insurance Rate Maps. The FIRM flood zones are shown on Map 3 in Appendix A and their definitions are listed below.

**Flood Insurance Rate Map Zone Definitions**

**Zone A** (1% annual chance): Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs (base flood elevations) or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

**Zone AE and A1-A30** (1% annual chance): Zones AE and A1-A30 are the flood insurance rate zones that correspond to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

**Zone X500** (0.2% annual chance)**:** Zone X500 is the flood insurance rate zone that corresponds to the 500-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs (base flood elevations) or depths are shown within this zone.

**Zone VE** (1% annual chance): Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

Locally Identified Areas of Flooding

In addition, information on other areas subject to flooding was provided by local officials on the Ipswich Hazard Mitigation Team. The Locally Identified Areas of Flooding described below were identified by Town staff as areas where flooding is known to occur. All of these areas do not necessarily coincide with the flood zones from the FIRM maps. Some may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. Some of these sites were carried over from the 2012 Hazard Mitigation Plan, and others were added to this plan update. The site numbers correspond to the numbers on Map 8, "Local Hazard Areas."

**Table 7: Locally Identified Areas of Flooding**

| ID# | Location | Comments |
|---|---|---|
| 2 | 102-112 County Road | Saltonstall Brook backs up at MA DOT culvert on Route 1A near 102 County Road |
| 4 | South End of Heartbreak Road | Floods occasionally due to site #2 |
| 3 | 12- 14 Heartbreak Road | Floods due to Saltonstall Brook backup in site #2 |
| 5 | Bull Brook culverts | Beaver dam activity during wet years causes flooding |
| 6 | Jeffreys Neck Road | Low spot on road floods during tidal storm surge events: isolates Great Neck and Little Neck from main parts of town |
| 7 | Pavilion Beach | Tidal surges flood Pavilion Beach area, potentially isolating Little Neck |
| 8 | Ipswich Mills Dam | Impacted area from Sally's Pond to County Street Bridge, including town center |
| 9 | Foote Brothers Dam | Has flooded at Gravelly Brook Road |
| 11 | Dow Reservoir Dam | |
| 12 | Miles River | |
| 13 | Beaver dams at New England Biolabs | |
| 14 | 187 County Road | Low lying section of road and beaver-induced flooding |
| 22 | High Street at Muddy River | Beaver-related flooding; Rt. 1A is main route; Browns Well may also be impacted |
| 23 | Sewer Infrastructure at Choate Bridge | Overflow issues with siphon |
| 24 | Water St. Flooding (also seawall at Town Wharf) | King tides flood to edge of street; tides are getting higher |
| 25 | Town Farm Road | |
| 26 | Island Park Road/Eagle Hill Road | |
| 27 | Jeffreys Neck Road | |
| 28 | Little Neck Road | |
| 29 | Argilla Road | |
| 30 | Water Street | |
| 31 | Municipal Parking Lot off of S. Main St. | |
| 32 | South main Street | |
| 33 | Market Street | |
| 34 | Hammatt Street Parking | |
| 35 | Municipal Parking Lot off of Hammat Street | |

Repetitive Loss Structures-

As defined by the National Flood Insurance Program (NFIP), a repetitive loss property is any property which the NFIP has paid two or more flood claims of $1,000 or more in any given 10-year period since 1978. For more information on repetitive losses see http://www.fema.gov/business/nfip/replps.shtm.

There is one repetitive loss property in Ipswich, a one single family residential structure. This property has experienced two losses totaling $2,662, as summarized in Table 8. The property is not located in a designated FEMA flood zone or a locally identified area of concern.

**Table 8- Summary of Repetitive Losses in Ipswich**

| | Single Family Residential | Non-Residential | Total |
|---|---|---|---|
| Number of Properties | 1 | 0 | 1 |
| Number of Losses | 2 | 0 | 2 |
| **Total Claims** | **$2,662** | **$0** | **$2,662** |

Source: Department of Conservation and Recreation, FEMA Repetitive Loss data

Based on the record of previous occurrences flooding events in Ipswich are a High frequency event as defined by the Massachusetts State Hazard Mitigation Plan. Thibbs hazard may occur more frequently than once in five years, or a greater than 20% chance per year.

Dams and Dam Failure

Dam failure can occur as a result of structural failure, independent of a hazard event, or as the result of the impacts of a hazard event such as flooding associated with storms or an earthquake. In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the area in the path of the dam's floodwaters.

The MA Department of Conservation and Recreation (DCR) Office of Dam Safety maintains an inventory of dams in Massachusetts. There are six dams listed in the Town of Ipswich, shown in Table 9. Three of the dams are municipally owned by the Ipswich Utilities Department, and three others are privately owned.

**Table 9 DCR Inventory of Dams in Bolton**

| Dam Name | Dam # | Owner | Hazard Potential |
|---|---|---|---|
| Dow Brook Reservoir Dam | MA00165 | Town of Ipswich Utilities Dept. | Significant |
| Bull Brook Reservoir Dam | MA00230 | Town of Ipswich Utilities Dept. | Low |
| Ipswich Mills Dam | MA00231 | Town of Ipswich | Low |
| Willowdale Dam | MA00276 | Private | Small Unregulated |
| Rantoul Pond | MA01207 | Belosselky Ipswich Realty Trust | Low |
| Argilla Farm Pond Dam | MA02989 | Private | Small Unregulated |

Source: MA Department of Conservation and Recreation Office of Dam Safety

DCR provides a classification of dam hazards, as summarized below. According to data provided by DCR, of the six dams in Ipswich, three are classified as low hazard potential, two are small unregulated dams, and one is considered significant hazard potential, the Dow Brook Reservoir Dam. There are no dams classified as "High" hazard potential.

**DCR Dam Hazard Classification**

**High**: Dams located where failure or mis-operation will likely cause loss of life and serious damage to homes(s), industrial or commercial facilities, important public utilities, main highways(s) or railroad(s).

**Significan**t: Dams located where failure or mis-operation may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities.

**Low**: Dams located where failure or mis-operation may cause minimal property damage to others. Loss of life is not expected.

The Dow Brook Reservoir Dam, which impounds a reservoir used for the Town's drinking water supply, is owned and operated by the Ipswich Utilities Department. In April 2018 seepage was observed on the downstream toe of the dam on the right side. An evaluation concluded that the seepage was causing erosion and if not addressed, could lead to dam failure, and the dam was found to be structurally deficient and in an unsafe condition. As an interim measure, the reservoir level was drawn down 30 inches to temporarily stop the seepage. The Town engaged a consultant to conduct assessments and designs for dam repairs. In June 2018 the DCR Office of Dam Safety issued a Dam Safety Order requiring the Town to:

1. Maintain a drawdown impoundment level
2. Conduct follow-up inspections
3. Conduct a Phase 2 investigation and inspections
4. Bring the dam into compliance and conduct all repair, breach, or removal work

The Town has engaged the firm of Haley and Aldrich to conduct this work

Dam failure is a highly infrequent occurrence but a severe incident could result in loss of lives and significant property damage. Since 1984, three dams have failed in or very near to Massachusetts, but a dam failure has never been recorded in the Town of Ipswich**.**

Based on the record of previous occurrences dam failure in Ipswich is a Very Low frequency event as defined by the Massachusetts State Hazard Mitigation Plan. This hazard may occur less frequently than once in 100 years (less than 1% chance per year).

**Coastal Hazards**

Coastal flooding is associated with severe coastal storms that, through the combination of winds and tides, drive tidal waters to higher levels than normally experienced. This can lead to the inundation of low-lying land areas and the overtopping of seawalls. Ipswich has extensive exposure to coastal flooding along large stretches of its coastline. Ipswich is particularly vulnerable because flooding may occur from two directions, flooding from the ocean, and from inundation from the Ipswich River flowing into the Great Marsh.

Coastal flooding issues in Ipswich include tidal surge and sea level rise; as well as coastal erosion (beaches, dunes, banks). Impacts to infrastructure, such as flooded roads, culverts blown out or clogging with debris, and power lines knocked down from high winds are also a significant concern in Ipswich.

Areas of town most affected by coastal storms include:

- **Roads:** Argilla Road, Jeffreys Neck Road, Little Neck Road, Labor in Vain Road, Town Farm Road, Island Park Road, Eagle Hill Road, and Water Street,

- **Houses and businesses:** in downtown Ipswich, on Little Neck, and on Jeffreys Neck Road, Argilla Road, Water Street, and Eagle Hill Road

- **Utilities:** the sewer trunk line and siphon near town hall, the powerline along Water Street

- **Public spaces/natural areas**: Town properties along tidal portions of the Ipswich River, Pavilion Beach primary frontal dune, Town Boat Launch, Crane Beach parking lot.

See photos of recent impacts to some of these areas in Figure 2.

The best available local data coastal flooding occurrences is for Essex County through the National Centers for Environmental Information (see Table 10). Essex County, which includes the Town of Ipswich, experienced 30 coastal flood events from 2006 to 2018. No deaths or injuries were reported and the total reported property damage in the county was $7.10 million dollars. Damages from the February and March 2013 coastal floods in Essex County accounted for $6.8 million of that total.

**Figure 2: Photos of Coastal Flooding in Ipswich**

**Water Street, 3-5-18**

**Jeffrey's Neck Road 3-22-18**

**Labor in Vain Road 3-5-18**

**Sewer Trunk Line 9-28-15**

**Table 10 Essex County Coastal Flood Events, 2006-2018**

| Date | Deaths | Injuries | Property Damage $ |
|---|---|---|---|
| 1/31/2006 | 0 | 0 | 60.00K |
| 4/15/2007 | 0 | 0 | 5.00K |
| 4/16/2007 | 0 | 0 | 5.00K |
| 4/17/2007 | 0 | 0 | 20.00K |
| 11/3/2007 | 0 | 0 | 10.00K |
| 11/25/2008 | 0 | 0 | 0.00K |
| 6/21/2009 | 0 | 0 | 0.00K |
| 1/2/2010 | 0 | 0 | 0.00K |
| 2/25/2010 | 0 | 0 | 0.00K |
| 3/1/2010 | 0 | 0 | 0.00K |
| 3/4/2010b | 0 | 0 | 0.00K |
| 3/15/2010 | 0 | 0 | 0.00K |
| 12/27/2010 | 0 | 0 | 75.00K |
| 10/30/2011 | 0 | 0 | 10.00K |
| 6/2/2012 | 0 | 0 | 0.00K |
| 6/3/2012 | 0 | 0 | 30.00K |
| 6/4/2012 | 0 | 0 | 0.00K |
| 6/4/2012 | 0 | 0 | 0.00K |
| 12/27/2012 | 0 | 0 | 0.00K |
| 2/9/2013 | 0 | 0 | 5.800M |
| 3/7/2013 | 0 | 0 | 1.000M |
| 1/2/2014 | 0 | 0 | 0.00K |
| 1/3/2014 | 0 | 0 | 0.00K |
| 1/27/2015 | 0 | 0 | 50.00K |
| 1/24/2016 | 0 | 0 | 0.00K |
| 2/8/2016 | 0 | 0 | 0.00K |
| 5/25/2017 | 0 | 0 | 40.00K |
| 1/4/2018 | 0 | 0 | 0.00K |
| 1/30/2018 | 0 | 0 | 0.00K |
| 3/2/2018 | 0 | 0 | 0.00K |
| **TOTAL** | **0** | **0** | **7.105M** |

Source: NOAA, National Centers for Environmental Information

The NOAA records for Essex County show a total of $7.1 million in damages from coastal flooding from 2006 to 2018. Based on the record of previous occurrences coastal flooding in Ipswich is a high frequency event as defined by the Massachusetts State Hazard Mitigation Plan. This hazard may occurs more frequently than once in 5 years (greater than 20% chance per year).

## Wind Related Hazards

Wind-related hazards include hurricanes, tropical storms, and tornadoes as well as high winds during Nor'easters and thunderstorms. As with many communities, falling trees that result in downed power lines and power outages are an issue in Ipswich. Information on wind related hazards can be found on Map 5 in Appendix B

Hurricanes and Tropical Storms

A hurricane is a violent wind and rainstorm with wind speeds of 74-200 miles per hour. A hurricane is strongest as it travels over the ocean and is particularly destructive to coastal property as the storm hits the land. The Town's entire area is vulnerable to hurricanes. Hurricanes occur between June and November. A tropical storm has similar characteristics, but wind speeds are below 74 miles per hour.

Since 1900, 39 tropical storms have impacted New England (NESEC). Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane. A hurricane or storm track is the line that delineates the path of the eye of a hurricane or tropical storm. There have been no recorded hurricanes that tracked directly through Ipswich, but one tropical storm tracked through the town in 1878. However, Ipswich experiences the impacts of hurricanes and tropical storms regardless of whether the storm track passes directly through the Town, and numerous hurricanes have affected the communities of eastern Massachusetts (see Table 11b) The hazard mapping indicates that the 100-year wind speed in Ipswich is 110 miles per hour (see Appendix B).

**Table 11- Hurricane Records for Massachusetts**

| Hurricane Event | Date |
|---|---|
| Great New England Hurricane | September 21, 1938 |
| Great Atlantic Hurricane | September 14-15, 1944 |
| Hurricane Doug | September 11-12, 1950 |
| Hurricane Carol | August 31, 1954 |
| Hurricane Edna | September 11, 1954 |
| Hurricane Diane | August 17-19, 1955 |
| Hurricane Donna | September 12, 1960 |
| Hurricane Gloria | September 27, 1985 |
| Hurricane Bob | August 19, 1991 |
| Hurricane Earl | September 4, 2010 |
| Tropical Storm Irene | August 28, 2011 |
| Hurricane Sandy | October 29-30, 2012 |

Source: National Oceanic and Atmospheric Administration

Hurricane intensity is measured according to the Saffir/Simpson scale, which categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential. These are combined to estimate potential damage. The

following gives an overview of the wind speeds, surges, and range of damage caused by different hurricane categories:

| Scale No. (Category) | Winds(mph) Storm | Surge (ft.) | Potential Damage |
|---|---|---|---|
| 1 | 74 – 95 | 4 - 5 | Minimal |
| 2 | 96 – 110 | 6 - 8 | Moderate |
| 3 | 111 – 130 | 9 - 12 | Extensive |
| 4 | 131 – 155 | 13 - 18 | Extreme |
| 5 | > 155 | >18 | Catastrophic |

Source: NOAA

Hurricanes typically have regional impacts beyond their immediate tracks. Falling trees and branches are a significant problem because they can result in power outages when they fall on power lines or block traffic and emergency routes. Hurricanes are a Town-wide hazard in Ipswich. Potential hurricane damages to Ipswich have been estimated using HAZUS-MH. Total damages are estimated at $39,554 thousand for a Category 2 hurricane and $39,554.12 thousand for a Category 4 hurricane. Other potential impacts are detailed in Table 21.

Based on records of previous occurrences, hurricanes in Ipswich are a Medium frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard occurs from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

Tornadoes

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. These events are spawned by thunderstorms and occasionally by hurricanes, and may occur singularly or in multiples. They develop when cool air overrides a layer of warm air, causing the warm air to rise rapidly. Most vortices remain suspended in the atmosphere. Should they touch down, they become a force of destruction. Some ingredients for tornado formation include:

- Very strong winds in the mid and upper levels of the atmosphere
- Clockwise turning of the wind with height (from southeast at the surface to west aloft)
- Increasing wind speed with altitude in the lowest 10,000 feet of the atmosphere (i.e., 20 mph at the surface and 50 mph at 7,000 feet.)
- Very warm, moist air near the ground with unusually cooler air aloft
- A forcing mechanism such as a cold front or leftover weather boundary from gprevious shower or thunderstorm activity

Tornado damage severity is measured by the Fujita Tornado Scale, in which wind speed is not measured directly but rather estimated from the amount of damage. As of February 01,

2007, the National Weather Service began rating tornados using the Enhanced Fujita-scale (EF-scale), which allows surveyors to create more precise assessments of tornado severity. The EF-scale is summarized below:

| Fujita Scale | | | Derived | | Operational EF Scale | |
|---|---|---|---|---|---|---|
| F Number | Fastest ¼ mile (mph) | 3-second gust (mph) | EF Number | 3-second gust (mph) | EF Number | 3-second gusts (mph) |
| 0 | 40-72 | 45-78 | 0 | 65-85 | 0 | 65-85 |
| 1 | 73-112 | 79-117 | 1 | 86-109 | 1 | 86-110 |
| 2 | 113-157 | 118-161 | 2 | 110-137 | 2 | 111-135 |
| 3 | 158-207 | 162-209 | 3 | 138-167 | 3 | 136-165 |
| 4 | 208-260 | 210-261 | 4 | 168-199 | 4 | 166-200 |
| 5 | 261-318 | 262-317 | 5 | 200-234 | 5 | Over -200 |

Source: Massachusetts State Hazard Mitigation Plan, 2013

The frequency of tornadoes in eastern Massachusetts is low; on average, there are six tornadoes that touchdown somewhere in the Northeast region every year. The strongest tornado in Massachusetts history was the Worcester Tornado in 1953 (NESEC).
The most recent tornado events in Massachusetts were in Springfield in 2011, Revere in 2014 and most recently in Concord (Middlesex County) on August 23, 2016. The Concord EF-1 tornado damaged 39 homes but no injuries or deaths were reported. (Source: *Concord Patch*) The Springfield tornado caused significant damage and resulted in 4 deaths in June of 2011. The Revere tornado touched down in Chelsea just south of Route 16 and moved north into Revere's business district along Broadway and ended near the intersection of Routes 1 and 60. The path was approximately two miles long and 3/8 mile wide, with wind speeds up to 120 miles per hour. Approximately 65 homes had substantial damages and 13 homes and businesses were uninhabitable.

Although there have been no recorded tornados within the limits of the Town of Ipswich, since 1956 there have been 11 tornadoes in surrounding Essex County recorded by the NCDC. No tornados were F3, one was F2, eight were F1 and two were F 0. These 11 tornados resulted in no fatalities and four injuries and up to $560,280 in damages, as summarized in Table 12.

**Table 12 - Tornado Records for Essex County**

| Date | Fujita Scale | Deaths | Injuries | Property Damage $ | Length | Width |
|---|---|---|---|---|---|---|
| 6/13/1956 | F1 | 0 | 0 | 2500 | 1 | 10 |
| 11/21/1956 | F2 | 0 | 0 | 25000 | 0.8 | 17 |
| 12/18/1956 | F1 | 0 | 0 | 250 | 0.5 | 23 |
| 7/13/1960 | F0 | 0 | 0 | 30 | 0.1 | 33 |

| Date | Fujita Scale | Deaths | Injuries | Property Damage $ | Length | Width |
|---|---|---|---|---|---|---|
| 7/21/1962 | F1 | 0 | 3 | 25000 | 2.7 | 33 |
| 5/19/1964 | F0 | 0 | 0 | 2500 | 0.1 | 300 |
| 5/19/1964 | F1 | 0 | 0 | 2500 | 2 | 300 |
| 8/10/1965 | F1 | 0 | 0 | 0 | 3.6 | 33 |
| 7/1/1968 | F1 | 0 | 1 | 250000 | 0.3 | 100 |
| 7/21/1972 | F1 | 0 | 0 | 2500 | 0.3 | 20 |
| 8/15/1991 | F1 | 0 | 0 | 250000 | 0.8 | 300 |
| | | **0** | **4** | **$560,280** | | |

Source: NOAA, National Centers for Environmental Information

Buildings constructed prior to current building codes may be more vulnerable to damages caused by tornadoes. Evacuation of impacted areas may be required on short notice. Sheltering and mass feeding efforts may be required along with debris clearance, search and rescue, and emergency fire and medical services. Key routes may be blocked by downed trees and other debris, and widespread power outages are also typically associated with tornadoes.

Although tornadoes are a potential Town-wide hazard in Ipswich, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Ipswich would greatly depend on the track of the tornado. Generally, the downtown, portions of the Town along the Route 1A corridor are more densely developed and would likely be subject to more damage in the event of a tornado.

Based on the record of previous occurrences since 1950, Tornado events in Ipswich are a Medium frequency event as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

Nor'easters

A northeast coastal storm, known as a nor'easter, is typically a large counter-clockwise wind circulation around a low-pressure center. Featuring strong northeasterly winds blowing in from the ocean over coastal areas, nor'easters are relatively common in the winter months in New England occurring one to two times a year. The storm radius of a nor'easter can be as much as 1,000 miles and these storms feature sustained winds of 10 to 40 mph with gusts of up to 70 mph. These storms are accompanied by heavy rains or snows, depending on temperatures.

Previous occurrences of Nor'easters include the following:

| | |
|---|---|
| February 1978 | Blizzard of 1978 |
| October 1991 | Severe Coastal Storm ("Perfect Storm") |

| | |
|---|---|
| December 1992 | Great Nor'easter of 1992 |
| January 2005 | Blizzard/N or'easter |
| October 2005 | Coastal Storm/Nor'easter |
| April 2007 | Severe Storms, Inland & Coastal Flooding/Nor'easter |
| January 2011 | Winter Storm/Nor'easter |
| October 2011 | Severe Storm/Nor'easter |
| February 2013 | Blizzard/ N or'easter |
| Jaunuary 2015 | Blizzard/ N or'easter |
| January 2018 | Severe Storm, Coastal Flooding/Nor'easter |

Many of the historic flood events identified in the previous section were precipitated by nor'easters, including the "Perfect Storm" event in 1991. More recently, blizzards in December 2010, October 2011, February 2013 and January 2015 were all large nor'easters that caused significant snowfall amounts.

The Town of Ipswich is vulnerable to both the wind and precipitation that accompanies nor'easters. High winds can cause damage to structures, fallen trees, and downed power lines leading to power outages. Intense rainfall can overwhelm drainage systems causing localized flooding of rivers and streams as well as urban stormwater ponding and localized flooding. Fallen tree limbs as well as heavy snow accumulation and intense rainfall can impede local transportation corridors, and block access for emergency vehicles.

The entire Town of Ipswich is at risk from the wind, rain or snow impacts from a nor'easter, and, depending on the track and radius of the storm, coastal hazards due to the Town's coastal location.

Based on the record of previous occurrences, nor'easters in Ipswich are high frequency events as defined by the Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

Severe Thunderstorms

While less severe than the other types of storms discussed, thunderstorms can lead to localized damage and represent a hazard risk for communities. Generally defined as a storm that includes thunder, which always accompanies lightning, a thunderstorm is a storm event featuring lightning, strong winds, and rain and/or hail. Thunderstorms sometime give rise to tornados. On average, these storms are only around 15 miles in diameter and last for about 30 minutes.

A severe thunderstorm can include winds of close to 60 mph and rain sufficient to produce flooding. The Town's entire area is potentially subject to severe thunderstorms.

The best available data on previous occurrences of thunderstorms is provided by NOAA's National Centers for Environmental Information for Essex County, which includes the Town of Ipswich. Since 1995 there were 80 thunderstorm events recorded in Essex County

(Table 13). These storms resulted in a total of $2.573 million in property damages. There were no injuries and no deaths reported.

**Table 13 Essex County Thunderstorm Wind Events, 1995-2017**

| Date | Magnitude-knots | Deaths | Injuries | Damage-$ |
|---|---|---|---|---|
| 9/14/1995 | 0 | 0 | 0 | 0 |
| 8/3/1997 | 50 | 0 | 0 | 0 |
| 5/29/1998 | 50 | 0 | 0 | 0 |
| 5/31/1998 | 50 | 0 | 0 | 0 |
| 8/11/1998 | 50 | 0 | 0 | 0 |
| 9/7/1998 | 50 | 0 | 0 | 0 |
| 4/26/1999 | 52 | 0 | 0 | 1000 |
| 6/23/1999 | 50 | 0 | 0 | 0 |
| 7/6/1999 | 52 | 0 | 0 | 0 |
| 7/24/1999 | 75 | 0 | 0 | 0 |
| 7/25/1999 | 50 | 0 | 0 | 0 |
| 6/27/2000 | 50 | 0 | 0 | 0 |
| 7/18/2000 | 50 | 0 | 0 | 0 |
| 5/12/2001 | 50 | 0 | 0 | 0 |
| 6/30/2001 | 50 | 0 | 0 | 0 |
| 7/1/2001 | 50 | 0 | 0 | 0 |
| 8/10/2001 | 50 | 0 | 0 | 0 |
| 5/31/2002 | 50 | 0 | 0 | 4000 |
| 6/2/2002 | 50 | 0 | 0 | 5000 |
| 7/23/2002 | 50 | 0 | 0 | 15000 |
| 6/27/2003 | 50 | 0 | 0 | 5000 |
| 7/2/2004 | 50 | 0 | 0 | 15000 |
| 8/20/2004 | 50 | 0 | 0 | 10000 |
| 6/26/2005 | 50 | 0 | 0 | 10000 |
| 6/29/2005 | 50 | 0 | 0 | 10000 |
| 7/27/2005 | 50 | 0 | 0 | 15000 |
| 8/5/2005 | 50 | 0 | 0 | 60000 |
| 5/21/2006 | 50 | 0 | 0 | 40000 |
| 7/11/2006 | 78 | 0 | 0 | 515000 |
| 7/28/2006 | 50 | 0 | 0 | 10000 |
| 6/1/2007 | 50 | 0 | 0 | 0 |
| 6/2/2007 | 50 | 0 | 0 | 0 |
| 7/5/2007 | 50 | 0 | 0 | 0 |
| 7/6/2007 | 50 | 0 | 0 | 0 |

| Date | Magnitude-knots | Deaths | Injuries | Damage-$ |
|---|---|---|---|---|
| 7/28/2007 | 50 | 0 | 0 | 0 |
| 9/8/2007 | 50 | 0 | 0 | 28000 |
| 5/27/2008 | 50 | 0 | 0 | 3000 |
| 6/10/2008 | 50 | 0 | 0 | 34000 |
| 6/22/2008 | 50 | 0 | 0 | 5000 |
| 6/27/2008 | 50 | 0 | 0 | 7500 |
| 7/1/2008 | 50 | 0 | 0 | 27000 |
| 7/2/2008 | 50 | 0 | 1 | 10000 |
| 7/3/2008 | 50 | 0 | 1 | 13000 |
| 7/18/2008 | 50 | 0 | 0 | 3000 |
| 7/19/2008 | 50 | 0 | 0 | 15000 |
| 9/9/2008 | 50 | 0 | 0 | 20000 |
| 7/26/2009 | 50 | 0 | 0 | 25000 |
| 7/31/2009 | 50 | 0 | 0 | 50500 |
| 6/3/2010 | 50 | 0 | 0 | 71000 |
| 6/5/2010 | 50 | 0 | 0 | 60000 |
| 6/6/2010 | 52 | 0 | 0 | 79500 |
| 6/24/2010 | 50 | 0 | 0 | 65750 |
| 7/12/2010 | 50 | 0 | 0 | 25000 |
| 7/19/2010 | 50 | 0 | 0 | 25000 |
| 6/9/2011 | 50 | 0 | 0 | 15000 |
| 6/9/2011 | 50 | 0 | 0 | 101000 |
| 7/4/2011 | 50 | 0 | 0 | 31000 |
| 7/18/2011 | 39 | 0 | 0 | 20000 |
| 8/19/2011 | 50 | 0 | 0 | 60000 |
| 10/4/2011 | 50 | 0 | 0 | 10000 |
| 6/23/2012 | 50 | 0 | 0 | 75500 |
| 6/25/2012 | 40 | 0 | 0 | 5000 |
| 7/4/2012 | 50 | 0 | 0 | 5000 |
| 6/24/2013 | 50 | 0 | 0 | 25000 |
| 7/1/2013 | 50 | 0 | 0 | 18000 |
| 7/3/2014 | 50 | 0 | 0 | 100000 |
| 7/15/2014 | 50 | 0 | 0 | 15000 |
| 7/28/2014 | 50 | 0 | 0 | 15000 |
| 9/2/2014 | 45 | 0 | 0 | 5000 |
| 9/6/2014 | 50 | 0 | 0 | 253000 |
| 5/28/2015 | 61 | 0 | 0 | 130100 |
| 6/23/2015 | 60 | 0 | 0 | 5000 |

| Date | Magnitude-knots | Deaths | Injuries | Damage-$ |
|---|---|---|---|---|
| 7/27/2015 | 45 | 0 | 0 | 1000 |
| 8/4/2015 | 50 | 0 | 0 | 70000 |
| 2/25/2016 | 45 | 0 | 0 | 21000 |
| 6/29/2016 | 50 | 0 | 0 | 25000 |
| 7/1/2016 | 50 | 0 | 0 | 15000 |
| 7/18/2016 | 70 | 0 | 0 | 105000 |
| 7/23/2016 | 50 | 0 | 0 | 155000 |
| 9/11/2016 | 50 | 0 | 0 | 10000 |
| **TOTAL** | | **0** | **2** | **$2,573,750** |

Source: NOAA National Centers for Environmental Information
Magnitude refers to maximum wind speed in knots.

Severe thunderstorms are a Town-wide hazard for Ipswich. The Town's vulnerability to severe thunderstorms is similar to that of Nor'easters. High winds can cause falling trees and power outages, as well as obstruction of key routes and emergency access. Heavy precipitation may also cause localized flooding, both riverine and urban drainage related.

Based on the record of previous occurrences, severe thunderstorms in Ipswich are high frequency events as defined by the 2013 Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in 5 years (greater than 20% per year).

**Winter Storms**

Winter storms, including heavy snow, blizzards, and ice storms, are the most common and most familiar of the region's hazards that affect large geographic areas. The majority of blizzards and ice storms in the region cause more inconvenience than they do serious property damage, injuries, or deaths. However, periodically, a storm will occur which is a true disaster, and necessitates intense large-scale emergency response.

Heavy Snow and Blizzards

A blizzard is a winter snow storm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow reducing visibility to or below ¼ mile. These conditions must be the predominant condition over a 3 hour period. Extremely cold temperatures are often associated with blizzard conditions, but are not a formal part of the definition. The hazard created by the combination of snow, wind and low visibility increases with temperatures below 20 degrees.

Winter storms are a combination hazard because they often involve wind, ice and heavy snow fall. The National Weather Service defines "heavy snow fall" as an event generating

at least 4 inches of snowfall within a 12 hour period. Winter Storms are often associated with a Nor'easter event, a large counter-clockwise wind circulation around a low-pressure center often resulting in heavy snow, high winds, and rain.

The Northeast Snowfall Impact Scale (NESIS) developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service (Kocin and Uccellini, 2004) characterizes and ranks high impact northeast snowstorms. These storms have large areas of 10 inch snowfall accumulations and greater. NESIS has five categories: Extreme, Crippling, Major, Significant, and Notable. NESIS scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers. The NESIS categories are summarized below:

| Category | NESIS | Value Description |
|---|---|---|
| 1 | 1—2.499 | Notable |
| 2 | 2.5—3.99 | Significant |
| 3 | 4—5.99 | Major |
| 4 | 6—9.99 | Crippling |
| 5 | 10.0+ | Extreme |

Source: Massachusetts State Hazard Mitigation Plan, 2013

The most significant winter storm in recent history was the "Blizzard of 1978," which resulted in over 3 feet of snowfall and multiple day closures of roadways, businesses, and schools. In Ipswich blizzards and severe winter storms have occurred in the following years:

**Table 14- Severe Winter Storm Records for Massachusetts**

| | |
|---|---|
| Blizzard of 1978 | February 1978 |
| Blizzard | March 1993 |
| Blizzard | January 1996 |
| Severe Snow Storm | March 2001 |
| Severe Snow Storm | December 2003 |
| Severe Snow Storm | January 2004 |
| Severe Snow Storm | January 2005 |
| Severe Snow Storm | April, 2007 |
| Severe Snow Storm | December 2010 |
| Severe Snow Storm | January 2011 |
| Blizzard of 2013 | February 2013 |
| Blizzard of 2015 | January 2015 |

Source: National Oceanic and Atmospheric Administration

The average annual snowfall for Ipswich is 48 - 72 inches. (See Map 6 in Appendix B).

The best available data on previous occurrences and impacts of heavy snow events is provided by NOAA's National Centers for Environmental Information for Essex County, which includes the Town of Ipswich. Since 1996 Essex County experienced 70 heavy snowfall events, resulting in no deaths, no injuries, and $7.353 million dollars in property damage (see Table 15).

**Table 15 - Heavy Snow events and Impacts in Essex County**

| Date | Deaths | Injuries | Damage-$ |
|---|---|---|---|
| 1/2/1996 | 0 | 0 | 0 |
| 1/7/1996 | 0 | 0 | 2000000 |
| 1/10/1996 | 0 | 0 | 0 |
| 1/12/1996 | 0 | 0 | 0 |
| 2/2/1996 | 0 | 0 | 0 |
| 2/16/1996 | 0 | 0 | 0 |
| 3/2/1996 | 0 | 0 | 0 |
| 3/7/1996 | 0 | 0 | 0 |
| 4/9/1996 | 0 | 0 | 0 |
| 12/6/1996 | 0 | 0 | 0 |
| 12/7/1996 | 0 | 0 | 1360000 |
| 12/7/1996 | 0 | 0 | 1360000 |
| 2/16/1997 | 0 | 0 | 0 |
| 3/31/1997 | 0 | 0 | 0 |
| 4/1/1997 | 0 | 0 | 2500000 |
| 11/14/1997 | 0 | 0 | 0 |
| 12/23/1997 | 0 | 0 | 0 |
| 1/15/1998 | 0 | 0 | 0 |
| 1/14/1999 | 0 | 0 | 0 |
| 3/6/1999 | 0 | 0 | 0 |
| 3/15/1999 | 0 | 0 | 0 |
| 1/13/2000 | 0 | 0 | 0 |
| 2/18/2000 | 0 | 0 | 0 |
| 12/30/2000 | 0 | 0 | 0 |
| 1/20/2001 | 0 | 0 | 0 |

| Date | Deaths | Injuries | Damage-$ |
|---|---|---|---|
| 2/5/2001 | 0 | 0 | 0 |
| 3/5/2001 | 0 | 0 | 0 |
| 3/9/2001 | 0 | 0 | 0 |
| 3/30/2001 | 0 | 0 | 0 |
| 12/8/2001 | 0 | 0 | 0 |
| 2/1/2003 | 0 | 0 | 0 |
| 2/1/2003 | 0 | 0 | 0 |
| 3/16/2004 | 0 | 0 | 0 |
| 3/16/2004 | 0 | 0 | 0 |
| 2/21/2005 | 0 | 0 | 0 |
| 1/23/2006 | 0 | 0 | 20000 |
| 12/13/2007 | 0 | 0 | 0 |
| 12/16/2007 | 0 | 0 | 0 |
| 12/19/2007 | 0 | 0 | 0 |
| 1/14/2008 | 0 | 0 | 48000 |
| 2/22/2008 | 0 | 0 | 0 |
| 12/19/2008 | 0 | 0 | 0 |
| 12/21/2008 | 0 | 0 | 0 |
| 12/31/2008 | 0 | 0 | 0 |
| 1/11/2009 | 0 | 0 | 0 |
| 1/18/2009 | 0 | 0 | 0 |
| 3/1/2009 | 0 | 0 | 0 |
| 3/9/2009 | 0 | 0 | 0 |
| 12/20/2009 | 0 | 0 | 0 |
| 1/18/2010 | 0 | 0 | 0 |
| 2/16/2010 | 0 | 0 | 15000 |
| 1/12/2011 | 0 | 0 | 0 |
| 1/26/2011 | 0 | 0 | 0 |
| 2/8/2013 | 0 | 0 | 0 |
| 3/7/2013 | 0 | 0 | 0 |
| 3/18/2013 | 0 | 0 | 0 |
| 12/14/2013 | 0 | 0 | 0 |
| 12/17/2013 | 0 | 0 | 0 |
| 1/2/2014 | 0 | 0 | 0 |
| 1/18/2014 | 0 | 0 | 10000 |
| 2/5/2014 | 0 | 0 | 0 |
| 2/13/2014 | 0 | 0 | 0 |
| 2/18/2014 | 0 | 0 | 0 |
| 1/24/2015 | 0 | 0 | 0 |

| Date | Deaths | Injuries | Damage-$ |
|---|---|---|---|
| 1/26/2015 | 0 | 0 | 0 |
| 2/2/2015 | 0 | 0 | 0 |
| 2/8/2015 | 0 | 0 | 0 |
| 2/14/2015 | 0 | 0 | 0 |
| 2/5/2016 | 0 | 0 | 40000 |
| **TOTAL** | **0** | **0** | **$7,353,000** |

Source: NOAA National Center Centers for Environmental Information

The Town's overall vulnerability to heavy snow and blizzards is primarily related to restrictions on travel on roadways, temporary road closures, school closures, and potential restrictions on emergency vehicle access. Other vulnerabilities include power outages due to fallen trees and utility lines, and damage to structures due to heavy snow loads.

Blizzards are considered to be high frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan. This hazard occurs more than once in five years, with a greater than 20 percent chance of occurring each year.

Ice Storms

The ice storm category covers a range of different weather phenomena that collectively involve rain or snow being converted to ice in the lower atmosphere leading to potentially hazardous conditions on the ground. Hail size typically refers to the diameter of the hailstones. Warnings and reports may report hail size through comparisons with real-world objects that correspond to certain diameters:

| Description | Diameter (inches) |
|---|---|
| Pea | 0.25 |
| Marble or Mothball | 0.50 |
| Penny or Dime | 0.75 |
| Nickel | 0.88 |
| Quarter | 1.00 |
| Half Dollar | 1.25 |
| Walnut or Ping Pong Ball | 1.50 |
| Golf ball | 1.75 |
| Hen's Egg | 2.00 |
| Tennis Ball | 2.50 |
| Baseball | 2.75 |
| Tea Cup | 3.00 |
| Grapefruit | 4.00 |
| Softball | 4.50 |

While ice pellets and sleet are examples of these, the greatest hazard is created by freezing rain, which is rain that freezes on contact with hard surfaces leading to a layer of ice on roads, walkways, trees, and other surfaces. The conditions created by freezing rain can make driving particularly dangerous and emergency response more difficult. The weight of ice on tree branches can also lead to falling branches damaging electric lines.

The best available data on ice storms is provided by the National Centers for Environmental Information for Essex County, which includes the Town of Ipswich. One ice storm was recorded in 2011 (see Table 16). No deaths or injuries were reported and the total reported property damage in the county was $2.0 million dollars.

**Table 16- Essex County Ice Storm Events**

| Date | Type | Deaths | Injuries | Damage-$ |
|---|---|---|---|---|
| 12/11/2008 | Ice Storm | 0 | 0 | $2,000,000 |

Source: NOAA National Center Centers for Environmental Information

Ice storms are considered to be medium frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2013. This hazard occurs once in 5 years to once in 50 years, with 2% to 20% chance of occurring each year.

The impacts of winter storms are often related to the weight of snow and ice, which can cause roof collapses and also causes tree limbs to fall which can in turn cause property damage and potential injuries as well as power outages.

Winter storms are a potential Town-wide hazard in Ipswich. The Town's vulnerability is primarily related to restrictions to travel on roadways, temporary road closures, school closures, and potential restrictions on emergency vehicle access. The Town works to clear roads and carries out general snow removal operations, and bans on-street parking during snow removal to ensure that streets can be plowed and public safety vehicle access is maximized. Transit operations may also be impacted, as they were in the 2015 blizzard which caused the closure of the MBTA system for one day and limited services on several transit lines for several weeks. Another winter storm vulnerability is power outages due to fallen trees and utility lines.

Winter storms are considered to be high frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan. This hazard occurs more than once in five years, with a greater than twenty percent chance of occurring each year.

**Geologic Hazards**

Geologic hazards include earthquakes and landslides. Although new construction under the most recent building codes generally will be built to seismic standards, there are still many structures which pre-date the most recent building code. Information on geologic hazards in Ipswich can be found on Map 4 in Appendix B.

Earthquakes

Damage in an earthquake stems from ground motion, surface faulting, and ground failure in which weak or unstable soils, such as those composed primarily of saturated sand or silts, liquefy. The effects of an earthquake are mitigated by distance and ground materials between the epicenter and a given location. An earthquake in New England affects a much wider area than a similar earthquake in California due to New England's solid bedrock geology (NESEC).

Seismologists use a Magnitude scale (Richter scale) to express the seismic energy released by each earthquake. The typical effects of earthquakes in various ranges are summarized below.

| **Richter Magnitudes** | **Earthquake Effects** |
|---|---|
| Less than 3.5 | Generally not felt, but recorded |
| 3.5- 5.4 | Often felt, but rarely causes damage |
| Under 6.0 | At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions. |
| 6.1-6.9 | Can be destructive in areas up to about 100 km. across where people live. |
| 7.0- 7.9 | Major earthquake. Can cause serious damage over larger areas. |
| 8 or greater | Great earthquake. Can cause serious damage in areas several hundred meters across. |

Source: Nevada Seismological Library (NSL), 2005

According to the State Hazard Mitigation Plan, New England experiences an average of five earthquakes per year. From 1668 to 2010, 544 earthquakes were recorded in Massachusetts (NESEC). Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Ann. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940, and a 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historical records of some of the more significant earthquakes in the region are shown in Table 14.

**Table 17- Historical Earthquakes in Massachusetts or Surrounding Area**

| Location | Date | Magnitude |
|---|---|---|
| MA - Cape Ann | 11/10/1727 | 5 |
| MA - Cape Ann | 12/29/1727 | NA |

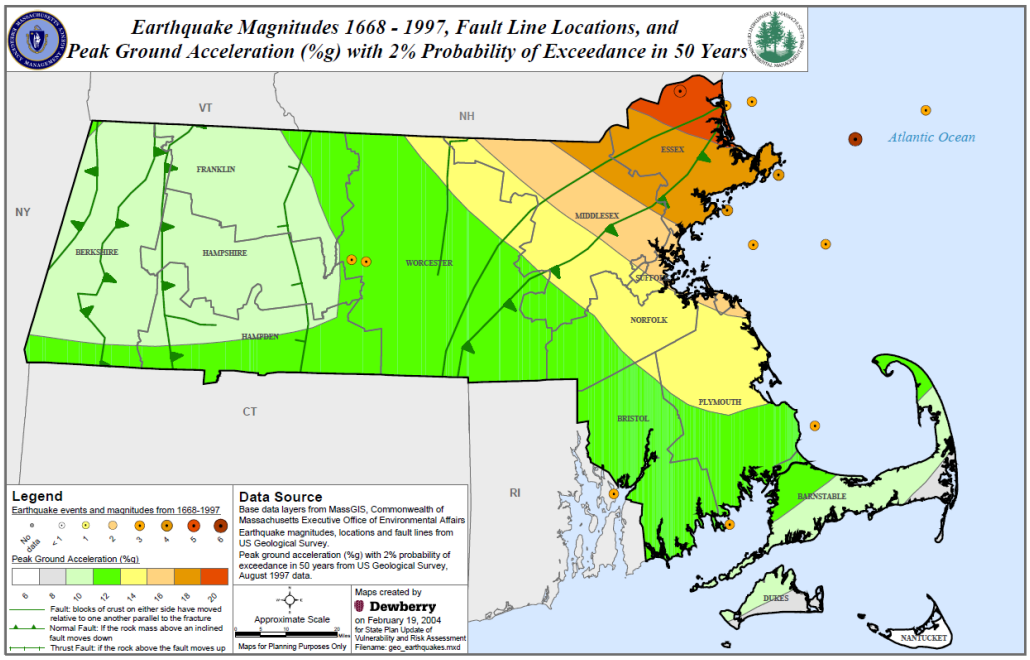
**Table 17- Historical Earthquakes in Massachusetts or Surrounding Area**

| Location | Date | Magnitude |
|---|---|---|
| MA – Cape Ann | 2/10/1728 | NA |
| MA – Cape Ann | 3/30/1729 | NA |
| MA – Cape Ann | 12/9/1729 | NA |
| MA – Cape Ann | 2/20/1730 | NA |
| MA – Cape Ann | 3/9/1730 | NA |
| MA - Boston | 6/24/1741 | NA |
| MA - Cape Ann | 6/14/1744 | 4.7 |
| MA - Salem | 7/1/1744 | NA |
| MA - Off Cape Ann | 11/18/1755 | 6 |
| MA – Off Cape Cod | 11/23/1755 | NA |
| MA - Boston | 3/12/1761 | 4.6 |
| MA - Off Cape Cod | 2/2/1766 | NA |
| MA - Offshore | 1/2/1785 | 5.4 |
| MA – Wareham/Taunton | 12/25/1800 | NA |
| MA - Woburn | 10/5/1817 | 4.3 |
| MA - Marblehead | 8/25/1846 | 4.3 |
| MA - Brewster | 8/8/1847 | 4.2 |
| MA - Boxford | 5/12/1880 | NA |
| MA - Newbury | 11/7/1907 | NA |
| MA - Wareham | 4/25/1924 | NA |
| MA – Cape Ann | 1/7/1925 | 4 |
| MA – Nantucket | 10/25/1965 | NA |
| MA – Boston | 12/27/74 | 2.3 |
| VA –Mineral | 8/23/11 | 5.8 |
| MA - Nantucket | 4/12/12 | 4.5 |
| ME - Hollis | 10/17/12 | 4.0 |

Source: NESEC.

One measure of earthquake risk is ground motion, which is measured as maximum peak horizontal acceleration, expressed as a percentage of gravity (1 g). The range of peak ground acceleration in Massachusetts is from 10g to 20g, with a 2% probability of exceedance in 50 years (Figure 3). Ipswich is in the middle to upper part of the range for Massachusetts, at 18g, making it a moderately high area of earthquake risk relative to the state, although the state as a whole is considered to have a low risk of earthquakes compared to the rest of the country. There have been no earthquake epicenters within Ipswich, although there have been several offshore earthquakes on the North Shore.

**Figure 3 Massachusetts Earthquake Peak Ground Acceleration Map**




Source: Dewberry, based on USGS Data

Although New England has not experienced a damaging earthquake since 1755, seismologists state that a serious earthquake occurrence is possible. There are five seismological faults in Massachusetts, but there is no discernible pattern of previous earthquakes along these fault lines. Earthquakes occur without warning and may be followed by aftershocks. Most older buildings and infrastructure were constructed without specific earthquake resistant design features.

Earthquakes are a hazard with multiple impacts beyond the obvious building collapse. Buildings may suffer structural damage which may or may not be readily apparent. Earthquakes can cause major damage to roadways, making emergency response difficult. Water lines and gas lines can break, causing flooding and fires. Another potential vulnerability is equipment within structures. For example, a hospital may be structurally engineered to withstand an earthquake, but if the equipment inside the building is not properly secured, the operations at the hospital could be severely impacted during an earthquake. Earthquakes can also trigger landslides.

Earthquakes are a potential Town-wide hazard in Ipswich. The Town has many older buildings that pre-date current building code which could be vulnerable in the event of a severe earthquake. The town identified several municipal facilities of concern, shown in Table 18. The ID numbers refer to the sites shown on the map series in Appendix B.

**Table 18: Areas of Concern for Earthquakes**

| Map ID # | Area of Concern |
|---|---|
| 15 | Main Fire Headquarters |

| | |
|---|---|
| 18 | Winthrop Elementary School |
| 17 | Town Hall |
| 16 | Police Station |
| 19 | Doyon Elementary School |
| 21 | Linebrook Fire Station |
| 20 | Department of Public Works |

Potential town-wide earthquake damages to Ipswich have been estimated using HAZUS-MH. Total building damages, including business interruption losses are estimated at $366 million for a 5.0 magnitude earthquake and $2,266 million for a 7.0 magnitude earthquake. Other potential impacts are detailed in Table 29.

According to the Boston College Weston Observatory, in most parts of New England, there is a one in ten chance that a potentially damaging earthquake will occur in a 50 year time period. The Massachusetts State Hazard Mitigation Plan classifies earthquakes as "very low" frequency events that occur less frequently than once in 100 years, or a less than 1% per year.

Landslides

According to the USGS, "The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors." Among the contributing factors are: erosion by rivers or ocean waves over steepened slopes; rock and soil slopes weakened through saturation by snowmelt or heavy rains; earthquakes create stresses that make weak slopes fail; and excess weight from accumulation of rain or snow, and stockpiling of rock or ore, from waste piles, or from man-made structures.

Landslides can result from human activities that destabilize an area or can occur as a secondary impact from another natural hazard such as flooding. In addition to structural damage to buildings and the blockage of transportation corridors, landslides can lead to sedimentation of water bodies. Typically, a landslide occurs when the condition of a slope changes from stable to unstable. Natural precipitation such as heavy snow accumulation, torrential rain and run-off may saturate soil creating instability enough to contribute to a landslide. The lack of vegetation and root structure that stabilizes soil can destabilize hilly terrain.

There is no universally accepted measure of landslide extent but it has been represented as a measure of the destructiveness. The table below summarizes the estimated intensity for a range of landslides. For a given landslide volume, fast moving rock falls have the highest intensity while slow moving landslides have the lowest intensity.

| **Estimated Volume** | **Expected Landslide Velocity** | | |
|---|---|---|---|
| ($m^{3)}$ | Fast moving landslide (Rock fall) | Rapid moving landslide (Debris flow) | Slow moving landslide (Slide) |
| <0.001 | Slight intensity | | |
| <0.5 | Medium intensity | | |
| >0.5 | High intensity | | |
| <500 | High intensity | Slight intensity | |
| 500-10,000 | High intensity | Medium intensity | Slight intensity |
| 10,000 – 50,000 | Very high intensity | High intensity | Medium intensity |
| >500,000 | | Very high intensity | High intensity |
| >>500,000 | | | Very high intensity |

Source: *A Geomorphological Approach to the Estimation of Landslide Hazards and Risks in Umbria, Central Italy*, M. Cardinali et al, 2002

Most of the Town of Ipswich has been classified as having a low incidence risk for landslides, less than 1.5 % of the area is involved in land sliding (Map 4, Appendix B). The eastern portion of town, predominantly the areas within the Great March, are classified as medium incidence risk. The Town does not have records of any damages caused by landslides in Ipswich.

Should a landslide occur in Ipswich, the type and degree of impacts would be highly localized, and the Town's vulnerabilities could include damage to structures, damage to infrastructure, and localized road closures. Potential damages would depend on which properties were affected. Given the relatively high assessed value of property in Ipswich, damages affecting a single residence could potentially exceed $500,000, and damages affecting several homes or business properties could theoretically exceed $1 million. However, there are no data available on actual landslide damages in Ipswich, as there are no records of any damages caused by landslides in the town. Injuries and casualties, while possible, would be unlikely given the low extent and impact of landslides in Ipswich.

Based on past occurrences and the Massachusetts Hazard Mitigation Plan, landslides are of Low frequency, events that can occur once in 50 to100 years (a 1% to 2% chance of occurring each year).

Tsunami

An additional natural hazard associated with earthquakes are tsunamis. Tsunamis are created when the epicenter of an earthquake, the area of the fault where a sudden rupture occurs, is beneath the ocean floor. This can sometimes create immense sea waves if the earthquake causes upward or downward movement of the sea floor. According to the National Centers for Environmental Information, there have been no Tsunami's reported in the Northeast area of the United States. The 2013 Massachusetts Natural Hazard Mitigation Plan reports tsunamis have a very low frequency with extensive and catastrophic severity across the coast of Massachusetts. Ipswich has a very low risk frequency of tsunami but if it were to occur, the damage would likely be extensive and catastrophic.

## Fire Related Hazards

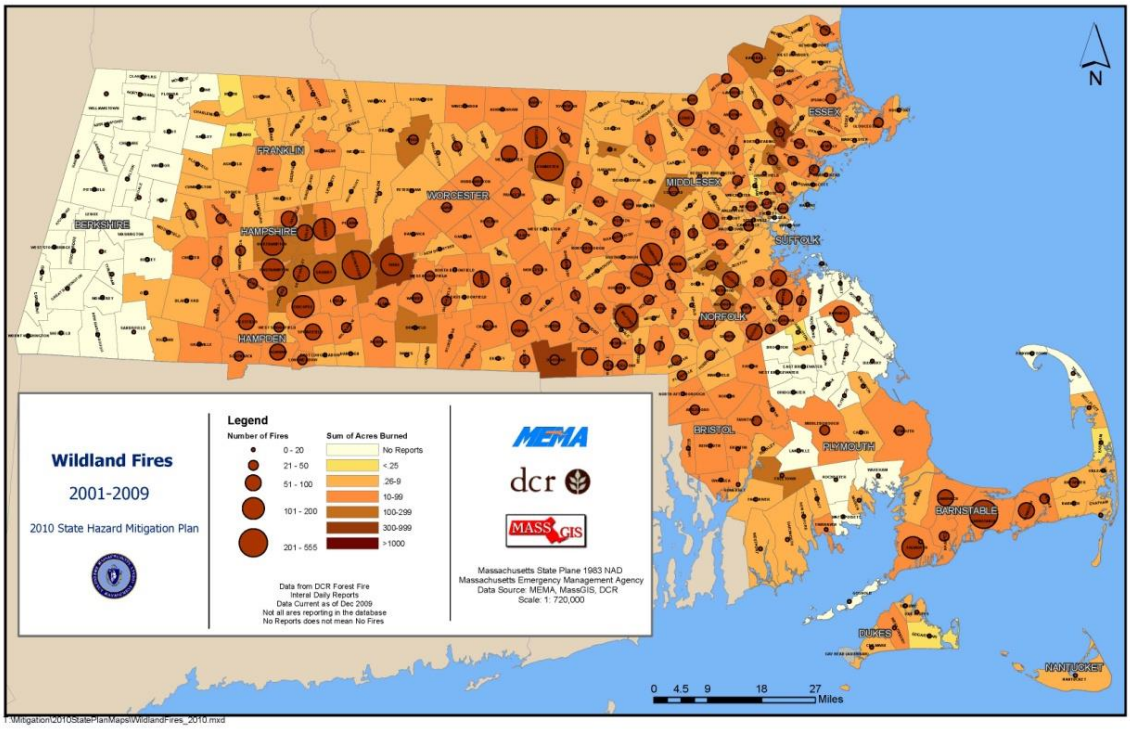
A brush fire is an uncontrolled fire occurring in a forested or grassland area. In the Boston Metro region these fires rarely grow to the size of a wildfire as seen more typically in the western U.S. As their name implies, these fires typically burn no more than the underbrush of a forested area. Wildfire season can begin in March and usually ends in late November. The majority of wildfires typically occur in April and May, when most vegetation is void of any appreciable moisture, making them highly flammable. Once "green-up" takes place in late May to early June, the fire danger usually is reduced somewhat.

These fires can present a hazard where there is the potential for them to spread into developed or inhabited areas, particularly residential areas where sufficient fuel materials might exist to allow the fire the spread into homes.

The Ipswich Fire Department has responds to an average of about 12-20 brush fires annually. These fires have not resulted in any significant property damage and there have been no deaths as a result of brush fires. The town considers brush fires to be a low to medium hazard risk. The areas with the highest incidence of brush fires are along the MBTA commuter rail tracks that run through the wooded areas of Ipswich. Sparks from train wheels on dry brush have caused several fires. Moderate risk areas for brush fires are located in the large tracts of open space in Ipswich, including Bradley Palmer State Park, Willowdale State Forest, and the Ipswich River Wildlife Refuge (MA Audubon).

Wildfires in Massachusetts are measured by the number of fires and the sum of acres burned. The most recent data available for wildfires in Massachusetts, shown in Figure 4 below, indicates that the wildfire extent in Ipswich consists of less than 25 acres burned, with 21- 50 fires from 2001 to 2009.

**Figure 4 Massachusetts Wildfires 2001-2009**




Source: Massachusetts State Hazard Mitigation Plan

Potential vulnerabilities to wildfires include damage to structures and other improvements, and impacts on natural resources such as Town conservation land. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly, and those with respiratory and cardiovascular diseases.

Potential damages from wildfires in; Ipswich would depend on the extent and type of land affected. There could be the need for post-fire revegetation to restore burned properties, which could cost from a few thousand dollars to tens of thousands for an extensive area. However, there are no data on actual wildfire damages.
Based on past occurrences and the Massachusetts Hazard Mitigation Plan, brushfires are of High frequency, events that occur more frequently than once in 5 years (Greater than 20% per year)

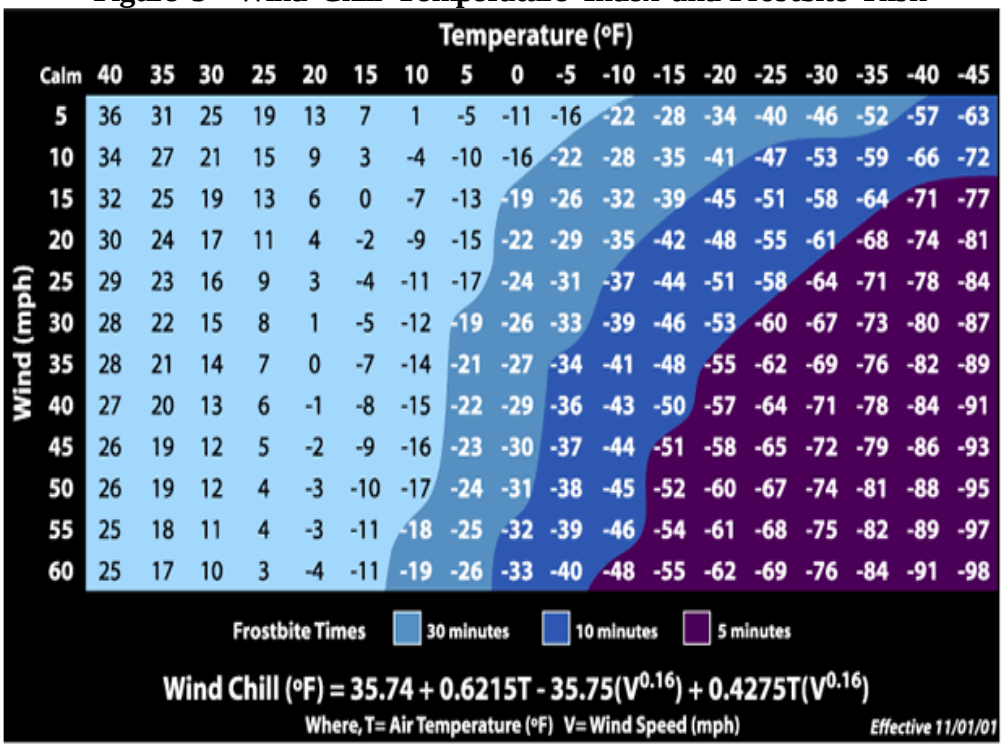
## Extreme Temperatures

Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over long periods of time when there is a prolonged period of excessively hot or cold weather. Ipswich has four well-defined seasons. The seasons have several defining factors, with temperature one of the most significant. Extreme temperatures can be defined as those, which are far outside of the normal seasonal ranges for Massachusetts.
The average temperatures for Massachusetts are: winter (Dec-Feb) Average = 31.8°F and summer (Jun-Aug) Average = 71°F. Extreme temperatures are a Town-wide hazard.

*Extreme Cold*

For extreme cold, temperature is typically measured using Wind Chill Temperature Index, which is provided by the National Weather Service (NWS). The latest version of the index was implemented in 2001 and it meant to show how cold conditions feel on unexposed skin. The index is provided in Figure 5.

**Figure 5 - Wind Chill Temperature Index and Frostbite Risk**




Extreme cold is also relative to the normal climatic lows in a region. Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind-chill factors. The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed.

Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat. The elderly and people with disabilities are often most vulnerable. In Ipswich, 17.8 percent of the population are over 65 and 4.5% of the population has a disability.

The best available local data on extreme cold are provided by NOAA's the National Centers for Environmental Information for Essex County, which includes the Town of Ipswich. There are four extreme cold events on record which caused no deaths and no injuries, and no property damage was reported (see Table 15).

**Table 19 – Essex County Extreme Cold and Wind Chill Occurrences**

| Date | Type | Deaths | Injuries | Damage-$ |
|---|---|---|---|---|
| 2/15/2015 | Extreme Cold/Wind Chill | 0 | 0 | 0 |
| 2/16/2015 | Extreme Cold/Wind Chill | 0 | 0 | 0 |
| 2/13/2016 | Extreme Cold/Wind Chill | 0 | 0 | 0 |
| 2/13/2016 | Extreme Cold/Wind Chill | 0 | 0 | 0 |

Source: NOAA, National Centers for Environmental Information

*Extreme Heat*

While a heat wave for Massachusetts is defined as three or more consecutive days above 90°F, another measure used for identifying extreme heat events is through a Heat Advisory from the NWS. These advisories are issued when the heat index (Figure 6) is forecast to exceed 100 degree Fahrenheit (F) for 2 or more hours; an excessive heat advisory is issued if forecast predicts the temperature to rise above105 degree F.

Extreme heat poses a potentially greater risk to the elderly, children, and people with certain medical conditions, such as heart disease. In Ipswich, 17.8 percent of the population are over 65 and 4.4% of the population is under the age of 5. However, even healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. Hot summer days can also worsen air pollution. With increased extreme heat, urban areas of the Northeast are likely to experience more days that fail to meet air quality standards.

**Figure 6- Heat Index Chart**

| Relative Humidity (%) \ Temperature (°F) | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 100 | 102 | 104 | 106 | 108 | 110 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 80 | 81 | 83 | 85 | 88 | 91 | 94 | 97 | 101 | 105 | 109 | 114 | 119 | 124 | 130 | 136 |
| 45 | 80 | 82 | 84 | 87 | 89 | 93 | 96 | 100 | 104 | 109 | 114 | 119 | 124 | 130 | 137 | |
| 50 | 81 | 83 | 85 | 88 | 91 | 95 | 99 | 103 | 108 | 113 | 118 | 124 | 131 | 137 | | |
| 55 | 81 | 84 | 86 | 89 | 93 | 97 | 101 | 106 | 112 | 117 | 124 | 130 | 137 | | | |
| 60 | 82 | 84 | 88 | 91 | 95 | 100 | 105 | 110 | 116 | 123 | 129 | 137 | | | | |
| 65 | 82 | 85 | 89 | 93 | 98 | 103 | 108 | 114 | 121 | 128 | 136 | | | | | |
| 70 | 83 | 86 | 90 | 95 | 100 | 105 | 112 | 119 | 126 | 134 | | | | | | |
| 75 | 84 | 88 | 92 | 97 | 103 | 109 | 116 | 124 | 132 | | | | | | | |
| 80 | 84 | 89 | 94 | 100 | 106 | 113 | 121 | 129 | | | | | | | | |
| 85 | 85 | 90 | 96 | 102 | 110 | 117 | 126 | 135 | | | | | | | | |
| 90 | 86 | 91 | 98 | 105 | 113 | 122 | 131 | | | | | | | | | |
| 95 | 86 | 93 | 100 | 108 | 117 | 127 | | | | | | | | | | |
| 100 | 87 | 95 | 103 | 112 | 121 | 132 | | | | | | | | | | |

| Category | Heat Index | Health Hazards |
|---|---|---|
| Extreme Danger | 130 °F – Higher | Heat Stroke or Sunstroke is likely with continued exposure. |
| Danger | 105 °F – 129 °F | Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity. |
| Extreme Caution | 90 °F – 105 °F | Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity. |
| Caution | 80 °F – 90 °F | Fatigue possible with prolonged exposure and/or physical activity. |

The best available local data on extreme heat are provided by NOAA's the National Centers for Environmental Information for Essex County, which includes the Town of Ipswich. There has been one excessive heat event reported, with no reported deaths, no injuries, and no property damage resulting from excessive heat (see Table 20).

**Table 20 – Essex County Extreme Heat Occurrences 1995 to April, 2017**

| Date | Type | Deaths | Injuries | Damage |
|---|---|---|---|---|
| 7/22/2011 | Excessive Heat | 0 | 0 | 0 |

Source: NOAA, National Centers for Environmental Information

Extreme temperature events are projected to be medium frequency events based on past occurrences, as defined by the Massachusetts State Hazard Mitigation Plan, 2013. Both extreme cold and hot weather events occur between once in five years to once in 50 years, or a 2 percent to 20 percent chance of occurring each year.

**Drought**

Drought is a temporary irregularity in precipitation and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. Drought is a period characterized by long durations of below normal precipitation. Drought conditions occur in virtually all climatic zones yet its characteristics vary significantly from one region

to another, since it is relative to the normal precipitation in that region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.

In Massachusetts, droughts are caused by the prevalence of dry northern continental air and a decrease in coastal- and tropical-cyclone activity. During the 1960's, a cool drought occurred because dry air from the north caused lower temperatures in the spring and summer of 1962-65. The northerly winds drove frontal systems to sea along the Southeast Coast and prevented the Northeastern States from receiving moisture (U.S. Geological Survey). This is considered the drought of record in Massachusetts.

Average annual precipitation in Massachusetts is 44 inches per year, with approximately 3 to 4 inch average amounts for each month of the year. Regional monthly precipitation ranges from zero to 17 inches. Statewide annual precipitation ranges from 30 to 61 inches. Thus, in the driest calendar year (1965), the statewide precipitation total of 30 inches was 68 percent of average.

Although Massachusetts is relatively small, it has a number of distinct regions that experience significantly different weather patterns and react differently to the amounts of precipitation they receive. The DCR precipitation index divides the state into six regions: Western, Central, Connecticut River Valley, Northeast, Southeast, and Cape and Islands. The Town of Ipswich is located in the Northeast Region. In Ipswich drought is a potential Town-wide hazard.

Five levels of drought have been developed to characterize drought severity: Normal, Advisory, Watch, Warning, and Emergency. These drought levels are based on the conditions of natural resources and are intended to provide information on the current status of water resources. The levels provide a basic framework from which to take actions to assess, communicate, and respond to drought conditions. They begin with a normal situation where data are routinely collected and distributed, move to heightened vigilance with increased data collection during an advisory, to increased assessment and proactive education during a watch. Water restrictions might be appropriate at the watch or warning stage, depending on the capacity of each individual water supply system. A warning level indicates a severe situation and the possibility that a drought emergency may be necessary. A drought emergency is one in which mandatory water restrictions or use of emergency supplies is necessary. Drought levels are used to coordinate both state agency and local response to drought situations.

As dry conditions can have a range of different impacts, a number of drought indices are available to assess these various impacts. Massachusetts uses a multi-index system that takes advantage of several of these indices to determine the severity of a given drought or extended period of dry conditions. Drought level is determined monthly based on the number of indices which have reached a given drought level. Drought levels are declared on a regional basis for each of six regions in Massachusetts. County by county or watershed-specific determinations may also be made.

A determination of drought level is based on seven indices:

1. Standardized Precipitation Index (SPI) reflects soil moisture and precipitation.
2. Crop Moisture Index: (CMI) reflects soil moisture conditions for agriculture.
3. Keetch Byram Drought Index (KBDI) is designed for fire potential assessment.
4. Precipitation Index is a comparison of measured precipitation amounts to historic normal precipitation.
5. The Groundwater Level Index is based on the number of consecutive month's groundwater levels are below normal (lowest 25% of period of record).
6. The Stream flow Index is based on the number of consecutive months that stream flow levels are below normal (lowest 25% of period of record).
7. The Reservoir Index is based on the water levels of small, medium and large index reservoirs across the state, relative to normal conditions for each month.

Ipswich follows a Drought Management Plan that defines specific actions associated with five local drought stages. Reservoir storage capacity and precipitation are the two primary factors in determining the local drought stage, which can vary from the statewide drought conditions due the small size and recharge capabilities of the town's reservoir system.

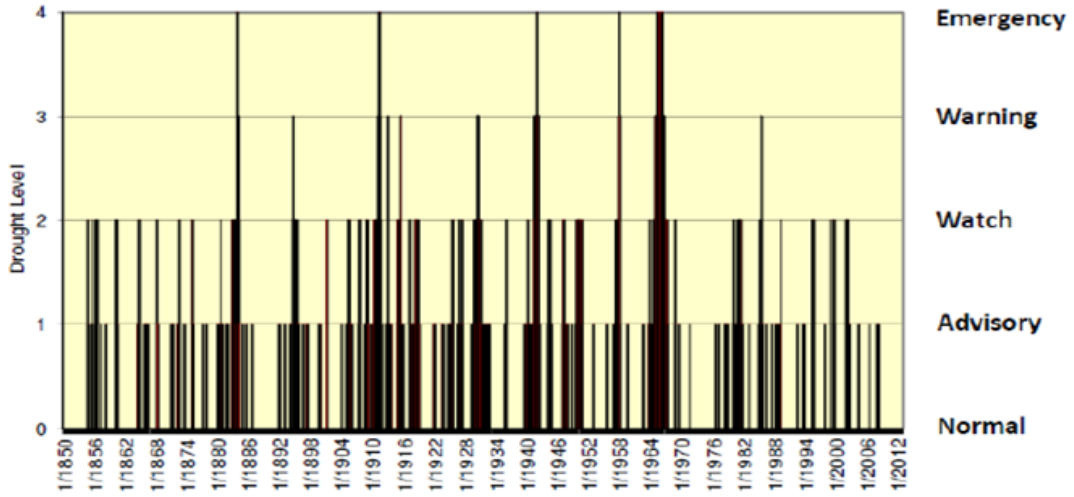
Determinations regarding the end of a drought or reduction of the drought level focus on two key drought indicators: precipitation and groundwater levels. These two factors have the greatest long-term impact on stream flow, water supply, reservoir levels, soil moisture and potential for forest fires.

Previous Occurrences

Because drought tends to be a regional natural hazard, this plan references state and county data as the best available data for drought. The statewide scale is a composite of six regions of the state. Regional composite precipitation values are based on monthly values from six stations, and three stations in the smaller regions (Cape Cod/Islands and West).

Figure 7 depicts the incidents of drought levels' occurrence in Massachusetts from 1850 to 2012 using the Standardized Precipitation Index (SPI) parameter alone. On a monthly basis, the state would have been in a Drought Watch to Emergency condition 11 percent of the time between 1850 and 2012. Table 21 summarizes the chronology of major droughts from 1929 to 2017.

**Figure 7 - Statewide Drought Levels using SPI Thresholds 1850 – 2012**




Source: Mass. State Drought Management Plan 2013

Drought Emergency

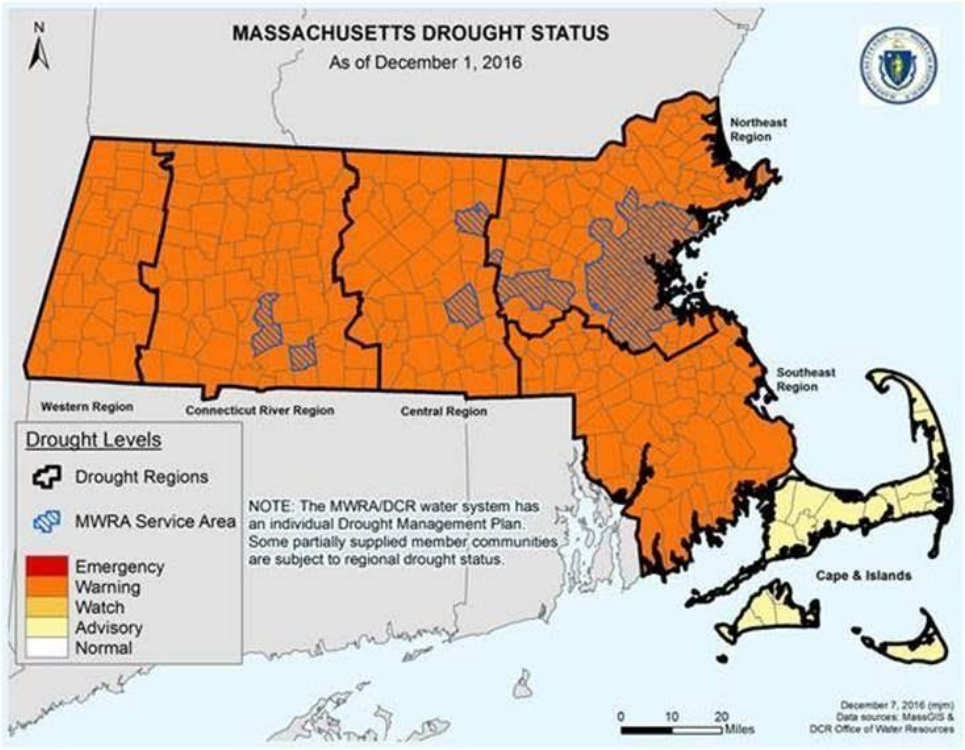
Drought emergencies have been reached infrequently, with 5 events occurring in the period between 1850 and 2012: in 1883, 1911, 1941, 1957, and 1965-1966. The 1965-1966 drought period is viewed as the most severe drought to have occurred in modern times in Massachusetts because of its long duration. On a monthly basis over the 162-year period of record, there is a one percent chance of being in a drought Emergency.

Drought Warning

Drought Warning levels not associated with Drought Emergencies have occurred five times, in 1894, 1915, 1930, 1985, and 2016. On a monthly basis over the 162-year period of record, there is a two percent chance of being in a drought Warning level.

The most recent drought to affect Ipswich was in 2016. As of July 2016, a Drought Warning had been declared for the Northeast region, which includes the Town of Ipswich. December 2016 marked the ninth consecutive month of below average rainfall, and Drought Warnings were extended to the entire state except the Cape and Islands (see Figure 8). However, with increased winter and spring precipitation in early 2017, conditions returned to normal by April 2017.

**Figure 8: Massachusetts Drought Status, December 2016**




Source: MA Department of Conservation and Recreation, Office of Water Resources

Drought Watch

Drought Watches not associated with higher levels of drought generally have occurred in three to four years per decade between 1850 and 1950. In the 1980s, there was a lengthy drought Watch level of precipitation between 1980 and 1981, followed by a drought Warning in 1985. A frequency of drought Watches at a rate of three years per decade resumed in the 1990s (1995, 1998, 1999). In the 2000s, Drought Watches occurred in 2001 and 2002.

On July 8, 2016, following four continuous months of unusually dry weather, Massachusetts Energy and Environmental Affairs (EEA) Secretary Matthew Beaton declared a Drought Watch for Central and Northeast Massachusetts, which includes the Town of Ipswich, and a Drought Advisory for Southeast Massachusetts and the Connecticut River Valley. In August 2016 the Northeast Region was upgraded to a Drought Warning. As of January 1, 2017, four of the six statewide regions in Massachusetts were listed in Drought Warning, the second highest drought stage, and the Northeast Region was listed in the third-ranked Drought Watch stage. By June 1, 2017 all areas of the state were listed as being in a normal condition.

The overall frequency of being in a drought Watch is 8 percent on a monthly basis over the 162-year period of record.

**Table 21 - Chronology of Major Droughts in Massachusetts**

| Date | Area affected | Recurrence interval (years) | Remarks |
|---|---|---|---|
| 1929-32 | Statewide | 10 to >50 | Water-supply sources altered in 13 communities. Multistate. |
| | Statewide | 15 to >50 | More severe in eastern and extreme western Massachusetts. Multistate. |
| 1957-59 | Statewide | 5 to 25 | Record low water levels in observation wells, northeastern Massachusetts. |
| 1961-69 | Statewide | 35 to >50 | Water-supply shortages common. Record drought. Multistate. |
| 1980-83 | Statewide | 10 to 30 | Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate. |
| 1985-88 | Housatonic River basin | 25 | Duration and severity unknown. Streamflow showed mixed trends elsewhere. |
| 2016 | Statewide | N/A | Drought declaration began in July 2016 with a Drought Watch, which was upgraded to a Drought Warning in August. |

Source: Massachusetts Drought Management Plan

Data on drought occurrences for Essex County, is available through the NOAA's National Centers for Environmental Information. From 1995 – 2017, there have been a total of 8 months of drought events, with no reported deaths, no injuries, and no property damage resulting from drought (see Table 22).

**Table 22 – Essex County Drought Occurrences 1995--2017**

| Date | Type | Deaths | Injuries | Damage-$ |
|---|---|---|---|---|
| 4/12/2012 | Drought | 0 | 0 | 0 |
| 7/5/2016 | Drought | 0 | 0 | 0 |
| 8/1/2016 | Drought | 0 | 0 | 0 |
| 9/1/2016 | Drought | 0 | 0 | 0 |
| 10/1/2016 | Drought | 0 | 0 | 0 |
| 11/1/2016 | Drought | 0 | 0 | 0 |
| 12/1/2016 | Drought | 0 | 0 | 0 |
| 1/1/2017 | Drought | 0 | 0 | 0 |
| **TOTAL** | | **0** | **0** | **0** |

Source: NOAA, National Centers for Environmental Information

During Ipswich's 2016 Emergency Declaration residents and businesses were asked to restrict even indoor water, as supply in the reservoir system was so low. Under a severe long-term drought, the Town of Ipswich could be vulnerable to restrictions on available water supply, as the town relies on local sources within the Ipswich River and Parker River watersheds. Potential damages of a severe drought could include losses of landscaped areas if outdoor watering is restricted and potential loss of business revenues if water supplies were severely restricted for a prolonged period. As this hazard has never occurred to such a degree in Ipswich, there are no data or estimates of potential damages, but under a severe drought scenario it would be reasonable to expect a range of potential damages from several million dollars.

Probability of Future Occurrences

The state has experienced Emergency Droughts five times between 1850 and 2012. Even given that regional drought conditions may occur at a different interval than state data indicates, droughts remain primarily regional or statewide phenomena in Massachusetts. Emergency Drought conditions over the 162 period of record in Massachusetts are a Low Frequency natural hazard event that can occur from once in 50 years to once in 100 years (1% to 2% chance per year), as defined by the Massachusetts State Hazard Mitigation Plan, 2013.

**Impacts of Climate Change**

Climate change is the most compelling environmental, economic, and social issue of our time. Many of the natural hazards that Ipswich has historically experienced are likely to be exacerbated by climate change in future years. This is particularly true for flooding caused by sea level rise, extreme precipitation and extreme heat.

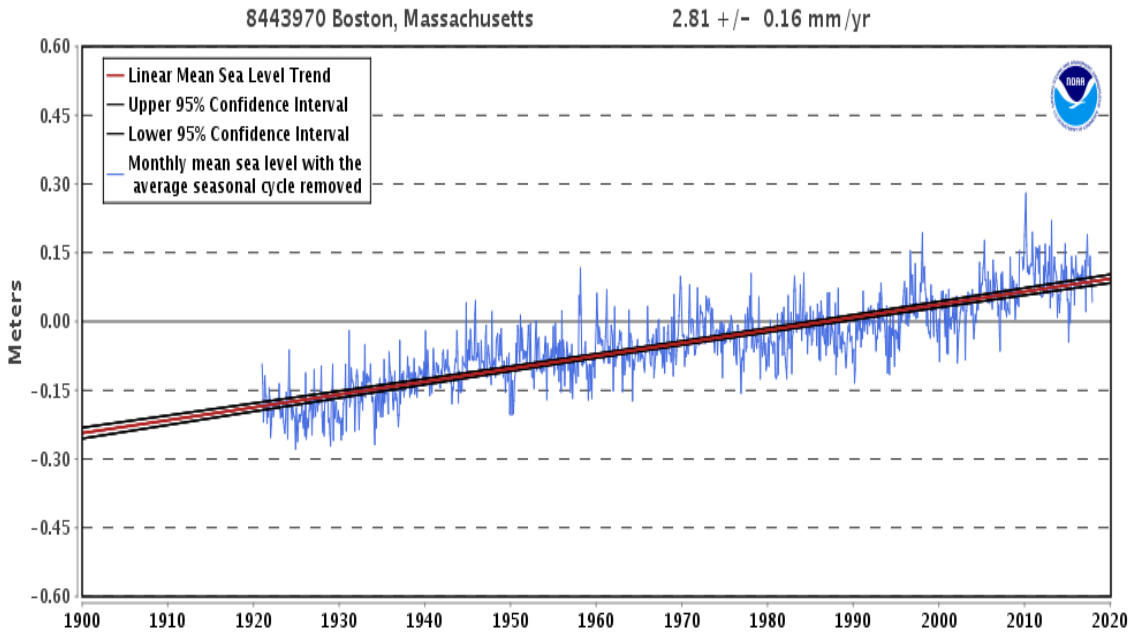
Ipswich is vulnerable to both riverine flooding and coastal flooding. Projected sea level rise and changes in intensity of storm and precipitation events stress the need to assess the vulnerability of Ipswich's people and places as well as plan for protecting its future. Extreme heat poses risk to public health, infrastructure deterioration, and natural systems and agriculture that function to support the community of Ipswich. It is important to address projected climate change conditions in order to comprehensively address natural hazard mitigation now and into the future, specifically for sea level rise, precipitation changes, and temperature changes.

Sea Level Rise

Over the last century, sea level in Massachusetts Bay has risen by 11 inches (Figure 9),Figure 9 Observed Sea Level Rise from Boston Tide Station and the Boston Research Advisory Group (BRAG) anticipates that the rate of increase will accelerate in the future,

anticipating an additional eight inches by 2030.[1,2] Warming temperatures contribute to sea level rise in several ways. First, warm water expands to take up more space. Second, rising temperatures are melting land-based ice which enters the oceans as meltwater. Other contributions to sea level rise include land subsidence and gravitational pull.

**Figure 9 Observed Sea Level Rise from Boston Tide Station**




There are several models and projections for future sea level rise available. The majority derive results that are relatively similar based upon some key assumptions, such as Greenhouse Gas (GHG) emission scenarios.

In 2019, we anticipate completion of a comprehensive SLR and storm surge analysis through the *Massachusetts Department of Transportation Coastal Transportation Vulnerability Assessment*. Comprised of the widely-accepted Advanced Circulation (ADCIRC) probabilistic model, this analysis is a high-resolution, hydrodynamic, probabilistic model that calculates probable future water flows as a result of tides, elevations, waves, winds, rivers, and various storms, accounting for inland storm runoff interaction with the coastal water activity at their interface in the model, with respect to state roads. This model has already been used for an analysis of Boston Harbor, called the Boston Harbor Flood Risk Model (BH-FRM) and is one of the most detailed projections

[1] U.S. Environmental Protection Agency. 2016. Climate Change Indicators in the United States, 2016. Fourth meditation. EPA 430-R-16-004. www.epa/gov/climate-indicators.
[2] Climate Ready Boston, "The Boston Research Advisory Group Report: Climate Change and Sea Level Rise Projections for Boston," June 2016

for coastal flooding available.[3] Finally, the Northeast Climate Science Center at UMass Amherst completed a SLR analysis for the Commonwealth in December 2017. This analysis is based upon the one used for Boston Harbor in *Climate Ready Boston* and a method recently used in Southern California.[4] This is a probabilistic model that projects changes in sea level based upon existing tide gauges. For Ipswich, the closest analysis is the Boston tide gauge. The projections of these two models are shown in Table 23.

**Table 23 Total Relative Sea Level Rise projections in Boston Harbor for the "Highest" emission scenarios.**

| | 2030 | 2050 | 2070 | 2100 |
|---|---|---|---|---|
| Boston BH_FRM [5] | 8.00 in. | 1.50 ft. | 3.10 ft. | 7.40 ft. |
| Boston Tide Gauge[6] | 1.2 ft. | 2.4 ft. | 4.2 ft. | 7.6 ft. |

These models can report the results of both medium and high GHG emission scenarios, but the highest emission scenarios are reported for total relative sea level rise in Table **.**

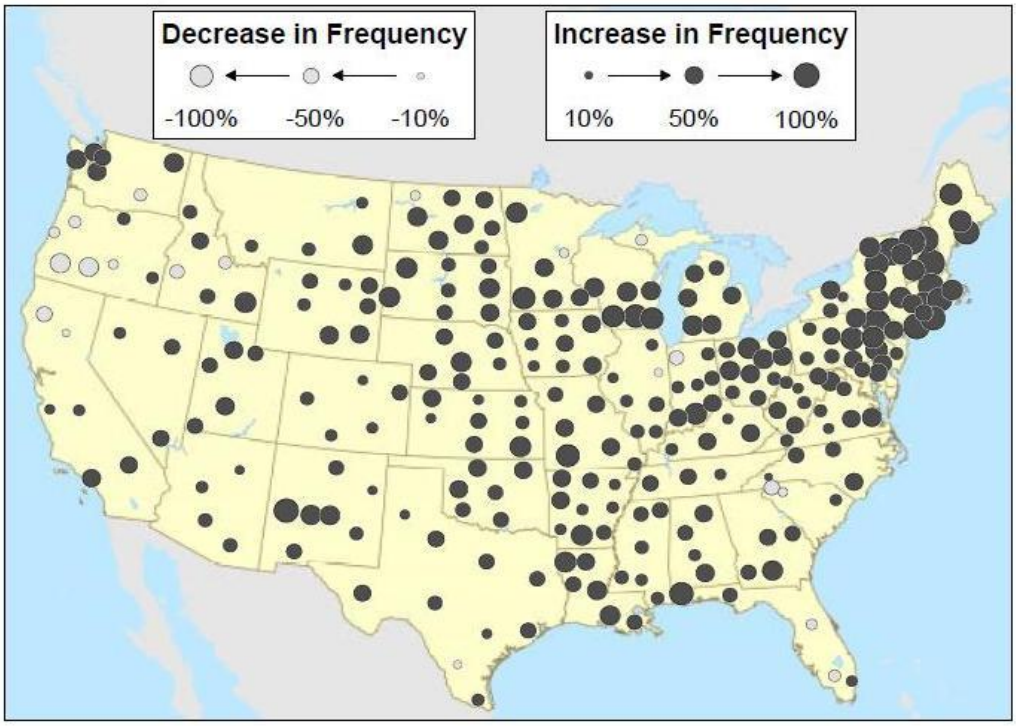
The Town of Ipswich has the opportunity to address climate change through the Municipal Vulnerability Preparedness (MVP) program. The town received an MVP grant in late 2017 that will enable it to convene key stakeholders to identify and prioritize the Town's climate vulnerabilities and begin to identify strategies to address these.

Extreme Precipitation

Ipswich's average annual precipitation is 47.83 inches. While total annual precipitation has not changed significantly, according to the 2012 report *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation from 1948 to 2011* intense rainstorms and snowstorms have become more frequent and more severe over the last half century in the northeastern United States**.** Extreme downpours are now happening 30 percent more often nationwide than in 1948 (see Figure 10). In other words, large rain or snow storms that happened once every 12 months, on average, in the middle of the 20th century, now happen every nine months.

[3] Bosma, K., Douglas, E., Kirshen, P., McArthur, K., and Miller, S. MassDOT-FHWA Pilot Project Report. Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery. June 2015.
[4] Northeast Climate Science Center. UMass Amherst. Massachusetts Climate Change Projections. December 2017.
[5] Douglas, E.M., Kirshen, P.H., Bosma, K., et al. 2017. Simulating the Impacts and Assessing the Vulnerability of the Central Artery/Tunnel System to Sea level Rise and Increased Coastal Flooding. J Extreme Events 3 (4): 1650013 (28 pages).
[6] Northeast Climate Science Center. UMass Amherst. "Massachusetts Climate Change Projections". December 2017

**Figure 10- Changes in Frequency of Extreme Downpours, 1948 – 2011**



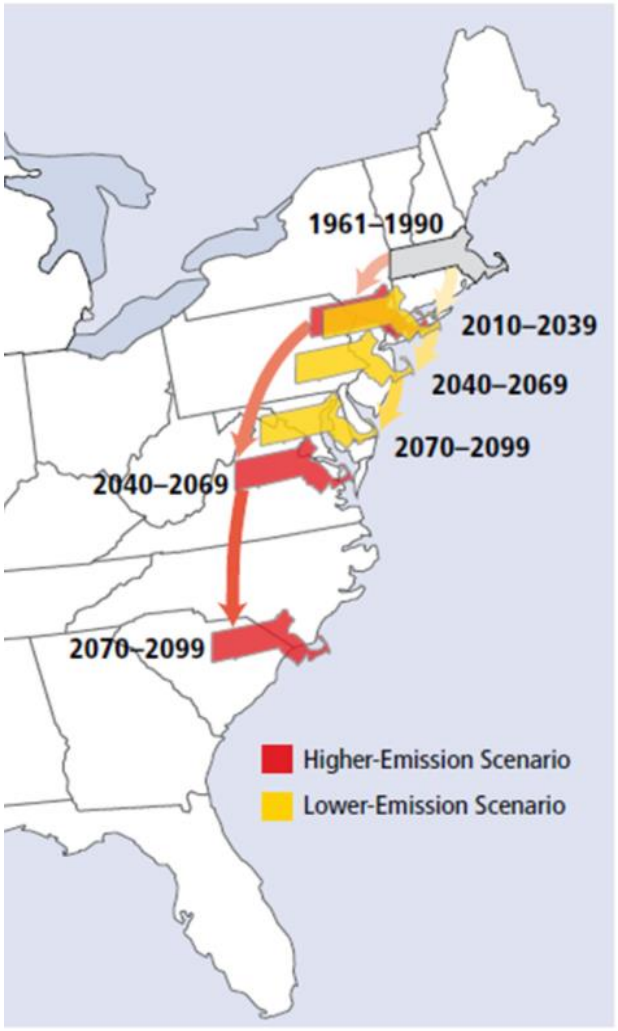

Source: *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation*, Environment America Research and Policy Center, July 2012

Not only are these intense storm events more frequent, they are also more severe: the largest annual storms now produce 10 percent more precipitation, on average, than in 1948. In particular, the report finds that New England has experienced the greatest change with intense rain and snow storms occurring 85 percent more often than in 1948.

At the other extreme, changes in precipitation patterns and the projected future rising temperatures due to climate change (discussed below) will likely increase the frequency of short-term (one- to three-month) droughts and decrease stream flow during the summer.

Extreme Heat

Recent temperature trends suggest greater potential impacts to come due to climate change. In the report "Confronting Climate Change in the U.S. Northeast," (2007), the Union of Concerned Scientists presented temperature projections to 2099 based on two scenarios, one with lower carbon dioxide emissions, and the other with high emissions.




Source: Union of Concerned Scientists

**Figure 11 – Mass. Extreme Heat Scenarios**

Between 1961 and 1990, Boston experienced an average of 11 days per year over 90°F. That could triple to 30 days per year by 2095 under the low emissions scenario, and increase to 60 days per year under the high emissions scenario. Days over 100°F could increase from the current average of one day per year to 6 days with low emissions or 24 days with high emissions. By 2099, Massachusetts could have a climate similar to Maryland's under the low emissions scenario, and similar to the Carolinas' with high emission (Figure 11). Furthermore, the number of days with poor air quality could quadruple in Boston by the end of the 21st century under higher emissions scenario, or increase by half under the lower emissions scenario. These extreme temperature trends could have significant impacts on public health, particularly for those individuals with asthma and other respiratory system conditions, which typically affect the young and the old more severely.

## Land Use and Development Trends

Existing Land Use

The most recent land use statistics available from the state are from aerial photography done in 2005. Table 24 shows the acreage and percentage of land in 30 categories. If the four residential categories are aggregated, residential uses make up 7.7 % of the area of the Town. Commercial and industrial uses combined make up 1.2 % of the Town.

**Table 24 Ipswich Land Use 2005**

| Land Use Category | Acres | Percent |
|---|---|---|
| Brushland/Successional | 49.74 | 0.24 |
| Cemetery | 36.80 | 0.17 |
| Commercial | 128.38 | 0.61 |
| Cropland | 1025.57 | 4.85 |
| Forest | 7346.69 | 34.72 |
| Forested Wetland | 1508.03 | 7.13 |
| Golf Course | 249.57 | 1.18 |
| High Density Residential | 318.70 | 1.51 |
| Industrial | 135.57 | 0.64 |
| Low Density Residential | 646.70 | 3.06 |
| Marina | 1.41 | 0.01 |
| Medium Density Residential | 442.00 | 2.09 |
| Mining | 94.05 | 0.44 |
| Multi-Family Residential | 223.94 | 1.06 |
| Non-Forested Wetland | 729.39 | 3.45 |
| Nursery | 31.34 | 0.15 |
| Open Land | 215.14 | 1.02 |
| Orchard | 74.09 | 0.35 |
| Participation Recreation | 88.87 | 0.42 |
| Pasture | 1072.53 | 5.07 |
| Powerline/Utility | 9.95 | 0.05 |
| Saltwater Sandy Beach | 1415.11 | 6.69 |
| Saltwater Wetland | 4172.98 | 19.72 |
| Transitional | 18.55 | 0.09 |
| Transportation | 30.15 | 0.14 |
| Urban Public/Institutional | 173.68 | 0.82 |
| Very Low Density Residential | 666.77 | 3.15 |
| Waste Disposal | 20.67 | 0.10 |
| Water | 234.91 | 1.11 |
| Water-Based Recreation | 0.62 | 0.00 |
| **Total** | **21,162hh** | |

Source: Mass GIS, MacConnell Land Use

For more information on how the land use statistics were developed and the definitions of the categories, please go to http://www.mass.gov/mgis/lus.htm.

Description and Economic Elements

The Town of Ipswich is a traditional New England community located in the eastern part of Essex County, in the northeastern part of Massachusetts, known as the North Shore. Ipswich is bordered by the town of Rowley on the north; Topsfield on the west; and Essex and Hamilton on the south. With a total area of 33 square miles, Ipswich is 30 miles north of Boston, and 12 miles south of Newburyport. Ipswich's location on the North Shore, with access to MBTA Commuter Rail, and state roadways such as Routes 1, 1A, and 133, provides an accessible commute to many employers within Metro Boston.

Ipswich is home to several large businesses, including the Ipswich Shellfish Company and New England Biolabs, as well as dozens of local businesses offering retail, restaurant, and diverse professional services. Total employment in the town is 4,667.

Recent and Potential Future Development

Development trends throughout the metropolitan region are tracked by MAPC's Development Database, which provides an inventory of new development over the last decade. The database includes three developments in the Town of Ipswich, two of which are residential and one is mixed use.

The database also includes several attributes of the new development, including site acreage, housing units, and commercial space. The developments in Ipswich include a total of 69 housing units, 8,000 square feet of commercial space, and are sited on a total of 39.1 acres (see Table 25).

**Table 25: Summary of Ipswich Developments**

| Name | Year Completed | Acres | Housing Units | Commercial Square Feet | Project Type |
|---|---|---|---|---|---|
| Whipple Riverview | 2006 | 0.1 | 1 | 0 | Residential |
| Partridgeberry Place | 2010 | 37 | 20 | 0 | Residential |
| Powderhouse Village | 2011 | 2 | 48 | 8000 | Mixed Use |
| **Total** | | **39.1** | **69** | **8000** | |

Source: Mass Builds Database, MAPC

In order to characterize any change in the Town's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites with the FEMA Flood Insurance Rate Map. The analysis shows that just one of these

development sites, Powderhouse Village, is are partially located within a Zone X b(0.2% annual chance of flooding). Typically, this portion of a development site is not the area to be built on.

In addition to the Mass Builds database, MAPC consulted with Town staff to determine areas that have been recently developed or may be developed in the future, based on the Town's comprehensive planning efforts and current trends and projects. Nine developments were identified, as shown in Table 26. These sites are also included in the map series (Appendix B), with the Site ID numbers indicating their location on the maps.

With respect to these development sites location in potential hazard areas, four of the nine sites are not located within a FEMA flood zone. Three sites are partially located within a Zone X (0.2% annual chance of flooding), and small portions of one site are located in FEMA flood zones: 5.43% of the site is in Zone AE (1% Annual Chance of Flooding, with BFE), and 1.57% of the site area is in AE (Regulatory Floodway). Typically, these small portions of a development site are not the area to be built on.

All of the development sites are within the area of "Low Incidence" for landslides and none are within a potential brushfire area.

With respect to other natural hazards, there is no geographic variability across the town. All of the potential development sites are located in the zone of 48 to 72 inches of average annual snowfall. The entire town is also within one zone for wind, which is a 100-year wind maximum speed of 110 miles per hour (Appendix B). Overall, Ipswich's potential future development would not significantly increase the town's vulnerability to natural hazards.

**Table 26: Recent and Potential Development in Relation to Hazard Areas**

| Site ID | Development | Landslide risk | Flood Zone | Brush Fire |
|---|---|---|---|---|
| A | Turner Hill | Low incidence | No | No |
| B | Willowdale Circle | Low incidence | 60.95% in X: 0.2% Annual Chance of Flooding | No |
| C | New England Biolabs | Low incidence | 5.43% in AE: 1% Annual Chance of Flooding, with BFE , and 1.57% in AE: Regulatory Floodway , and 3.29% in X: 0.2% Annual Chance of Flooding | No |
| N | Kozinsky Farm | Low incidence | No | No |
| Q | 59 Turnpike | Low incidence | 0.86% in X: 0.2% Annual Chance of Flooding | No |
| P | Town Farm Road | Low incidence | No | No |
| S | Commercial Sites Near Shaws Plaza | Low incidence | No | No |

| | | | | |
|---|---|---|---|---|
| O | Bruni's | Low incidence | No | No |
| R | New Elementary School | Low incidence | 8.06% in X: 0.2% Annual Chance of Flooding | No |

## Critical Infrastructure in Hazard Areas

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, hospitals, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). It also includes facilities that might pose a particular danger during a natural disaster such as a sewage treatment plant or chemical facility. There are 94 facilities identified in Ipswich. These facilities are listed in Table 27 and are shown on the map series in Appendix B.

The purpose of mapping the natural hazards and critical infrastructure is to present an overview of hazards in the community and how they relate to critical infrastructure. The categories of hazards mapped are explained below:

**Explanation of Columns in Table 27**

***Column 1: ID #:*** The first column in Table 10 is an ID number which appears on the maps that are part of this plan. See Appendix B.

***Column 2: Name:*** The second column is the name of the site. If no name appears in this column, this information was not provided to MAPC by the community.

***Column 3: Type*:** The third column indicates what type of site it is.

***Column 4: Landslide Risk:*** The fourth column indicates the degree of landslide risk for that site. This information came from NESEC. The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. This mapping is highly general in nature. For more information on how landslide susceptibility was mapped, refer to http://pubs.usgs.gov/pp/p1183/pp1183.html.

***Column 5: FEMA Flood Zone*:** The fifth column addresses the risk of flooding. A "No" entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone.

***Column 6: Locally Identified Areas of Flooding***—Areas of town identified by the Local Hazard Mitigation Team as subject to local flooding, even if not within a FEMA designated flood zone.

***Column 7. Brush Fires***- Areas determined by Local Hazard Mitigation Team to be at risk for brush fires.

**Column 8**: **Snowfall—**Average Annual Snowfall in inches. This information came from NESEC

***Column 9: Hurricane Surge Category***: This column indicates whether or not the site is located within a hurricane surge area and the category of hurricane estimated to be necessary to cause inundation of the area. The following explanation of hurricane surge areas was taken from the US Army Corps of Engineers web site: "Hurricane storm surge is an abnormal rise in sea level accompanying a hurricane or other intense storm. Along a coastline a hurricane will cause waves on top of the surge. Hurricane Surge is estimated with the use of a computer model called SLOSH. SLOSH stands for Sea Lake and Overland Surge from Hurricanes. The SLOSH models are created and run by the National Hurricane Center. The SLOSH model results are merged with ground elevation data to determine areas that will be subject to flooding from various categories of hurricanes.

## Table 27: Critical Facilities in Relation to Hazard Areas

| SITE ID# | NAME | TYPE | Landslide Incidence | FEMA_Flood _Zone | Locally_Identified _Area_of_Flooding | Brush Fire Area | Avg_Annual_ Snow_Fall (in) | Hurricane Surge Areas |
|---|---|---|---|---|---|---|---|---|
| 1 | Small Wonders Child Development Center | Child Care | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 2 | Ascension Nursery School | Child Care | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 3 | Small World Nursery School | Child Care | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 4 | Cuvilly Arts and Earth Center Preschool | Child Care | Mod. incidence | No | No | No | 48.1 - 72.0 | 0 |
| 5 | First Class Child Care Center | Child Care | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 6 | Ipswich Fire Department | Fire Station | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 7 | Ipswich Fire Station | Fire Station | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 8 | Ipswich Police Department | Police Station | Low incidence | No | No | No | 48.1 - 72.0 | 4 |
| 9 | Ipswich Town Hall | Municipal | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 10 | Lahey Clinic | Medical Facility | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 11 | Ipswich Middle School | School | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 12 | Winthrop Elementary School | School | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 13 | Paul F Doyon Memorial Elementary | School | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 14 | Ipswich High | School | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 15 | Hill House | School | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 16 | Ipswich Public Schools, Administration | Municipal | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 17 | Ipswich Utilities Dept. | Municipal | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 18 | New England BioLabs | Haz Material Site | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 19 | Sisters Of Notre Dame | Nursing Home | Mod. incidence | No | No | No | 48.1 - 72.0 | 0 |
| 20 | Oak Hill Apts | Elder Housing | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 21 | Verizon | Communication Tower | Low incidence | No | No | No | 48.1 - 72.0 | 4 |
| 22 | Ipswich Waste Water Treatment | Sewer Pump Station | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 23 | Green St bridge | Bridge | | AE: 1% Annual Chance; w/ BFE | No | No | 48.1 - 72.0 | 0 |

| SITE ID# | NAME | TYPE | Landslide Incidence | FEMA_Flood _Zone | Locally_Identified _Area_of_Flooding | Brush Fire Area | Avg_Annual_ Snow_Fall (in) | Hurricane Surge Areas |
|---|---|---|---|---|---|---|---|---|
| 24 | Choate bridge | Bridge | | AE: 1% Annual Chance; w/ BFE | South main Street | No | 48.1 - 72.0 | 0 |
| 25 | County St bridge | Bridge | | AE: 1% Annual Chance; w/ BFE | No | No | 48.1 - 72.0 | 0 |
| 26 | Labor-in-Vain Road bridge | Bridge | | AE: 1% Annual Chance; w/ BFE | No | No | 48.1 - 72.0 | 0 |
| 27 | MBTA Rail Bridge | Bridge | | AE: Regulatory Floodway | No | No | 48.1 - 72.0 | 0 |
| 28 | Mill Road bridge | Bridge | | AE: Regulatory Floodway | No | No | 48.1 - 72.0 | 0 |
| 29 | Winthrop St Bridge | Bridge | | AE: Regulatory Floodway | No | No | 48.1 - 72.0 | 0 |
| 30 | Willowdale Dam | Dam | | AE: Regulatory Floodway | Foote Brothers Dam | No | 48.1 - 72.0 | 0 |
| 31 | Ipswich Mills Dam | Dam and River Walk | | AE: Regulatory Floodway | Ipswich Mills Dam | No | 48.1 - 72.0 | 0 |
| 32 | Fox Creek bridge | Bridge | Moderate incidence | AE: 1% Annual Chance; w/ BFE | Argilla Road | No | 48.1 - 72.0 | 1 |
| 33 | Appleton bridge | Bridge | Low incidence | AE: Regulatory Floodway | No | No | 48.1 - 72.0 | 0 |
| 34 | High Street MBTA Rail Bridge | Bridge | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 35 | Dow Brook Dam | Dam | Low incidence | No | Dow Reservoir Dam | No | 48.1 - 72.0 | 0 |
| 36 | Bull Brook Dam | Dam | Low incidence | A: 1% Annual Chance; no BFE | No | No | 48.1 - 72.0 | 0 |
| 37 | High St Sub Station | Power Substation | Low incidence | No | No | No | 48.1 - 72.0 | 4 |
| 38 | Ipswich Power Plant | Power Plant | Low incidence | No | Dow Reservoir Dam | No | 48.1 - 72.0 | 4 |
| 39 | Ipswich Water Treatment Plant | Water Treatment | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 40 | Town hill Water Storage Tank | Water Storage Tank | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 41 | Fowlers Lane Sub Station | Power Substation | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 42 | Vernette Court Sub Station | Power Substation | Low incidence | No | No | No | 48.1 - 72.0 | 0 |

| SITE ID# | NAME | TYPE | Landslide Incidence | FEMA_Flood _Zone | Locally_Identified _Area_of_Flooding | Brush Fire Area | Avg_Annual_ Snow_Fall (in) | Hurricane Surge Areas |
|---|---|---|---|---|---|---|---|---|
| 43 | Pinefield Water Storage Tank | Water Storage Tank | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 44 | Ipswich County Club | Waste Water Treatment | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 45 | Plover Hill Water Storage Tank | Water Storage Tank | Moderate incidence | No | No | No | 48.1 - 72.0 | 0 |
| 46 | NE Biolab - Waste water treatment | Waste Water Treatment | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 47 | Turner Hill Waste Water Treatment | Waste Water Treatment | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 48 | Winthrop well #2 | Well | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 49 | Winthrop Well #1 | Well | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 50 | Browns Well | Well | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 51 | Mill Lane well and booster station | Well / Power Booster Station | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 52 | Fellows Road Well | Well | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 53 | Essex Road Well | Well | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 54 | Jefferies Neck Booster Station | Booster Station | Moderate incidence | No | No | No | 48.1 - 72.0 | 0 |
| 55 | Plover Hill Communications | Communication Tower | Moderate incidence | No | No | No | 48.1 - 72.0 | 0 |
| 56 | Town hill Communications | Communication Tower | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 57 | Pinefiield Tank communications | Communication Tower | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 58 | Cable Gardens Elder Housing | Elder Housing | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 59 | DPW Garage | Municipal | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 60 | Town Wharf Sewer Pump Station | Waste Water Pump Station | Moderate incidence | AE: 1% Annual Chance; w/ BFE | No | No | 48.1 - 72.0 | 2 |
| 61 | Town Wharf | Town Wharf | Moderate incidence | AE: 1% Annual Chance; w/ BFE | No | No | 48.1 - 72.0 | 1 |
| 62 | Cemetery Office | | Low incidence | No | No | No | 48.1 - 72.0 | 0 |

| SITE ID# | NAME | TYPE | Landslide Incidence | FEMA_Flood _Zone | Locally_Identified _Area_of_Flooding | Brush Fire Area | Avg_Annual_ Snow_Fall (in) | Hurricane Surge Areas |
|---|---|---|---|---|---|---|---|---|
| 63 | Animal Control Office | Municipal | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 64 | Eagle Hill Landing | Water Access | Moderate incidence | AE: 1% Annual Chance; w/ BFE | No | No | 48.1 - 72.0 | 1 |
| 65 | Pavilion Beach and Landing | Water Access | Moderate incidence | VE: High Risk Coastal Area | Pavilion Beach | No | 48.1 - 72.0 | 1 |
| 66 | Wind Turbines | Wind Turbines | Moderate incidence | No | No | No | 48.1 - 72.0 | 0 |
| 67 | Compost Facility | Waste Disposal | Moderate incidence | No | No | No | 48.1 - 72.0 | 4 |
| 68 | Residence at Riverbend | Assisted Living | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 69 | Waldingfield Rd. Bridge (MBTA) | Bridge | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 70 | Gravelly Brook Culvert under Topsfield Rd. | Culvert | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 71 | Bull Brook Culvert under Linebrook Rd. | Culvert | Low incidence | A: 1% Annual Chance; no BFE | No | No | 48.1 - 72.0 | 0 |
| 72 | Ipswich Public Library | Library | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 73 | Kimball Ave. Sewer Pump Station | Waste Water Pump Station | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 74 | LeBlanc Pump Station | Waste Water Pump Station | Low incidence | No | No | No | 48.1 - 72.0 | 4 |
| 75 | Lappin Pump Station | Waste Water Pump Station | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 76 | Habitat Pump Station | Waste Water Pump Station | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 77 | Sewer Trunk Line and Siphon | Sewer Trunk Line | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 78 | YMCA | YMCA | Low incidence | No | 102-112 County Rd | No | 48.1 - 72.0 | 0 |
| 79 | Day Care | Day Care | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 80 | Dow Reservoir | Reservoir (Water Supply) | Low incidence | A: 1% Annual Chance; no BFE | No | No | 48.1 - 72.0 | 0 |
| 81 | Bull Brook Reservoir | Reservoir (Water Supply) | Low incidence | A: 1% Annual Chance; no BFE | No | No | 48.1 - 72.0 | 0 |

| SITE ID# | NAME | TYPE | Landslide Incidence | FEMA_Flood _Zone | Locally_Identified _Area_of_Flooding | Brush Fire Area | Avg_Annual_ Snow_Fall (in) | Hurricane Surge Areas |
|---|---|---|---|---|---|---|---|---|
| 82 | Water Street Seawall | Seawall | Moderate incidence | AE: 1% Annual Chance; w/ BFE | Water Street | No | 48.1 - 72.0 | 1 |
| 83 | Sewer trunk line and siphon | Sewer | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 84 | YMCA | YMCA | Low incidence | No | 102-112 County Rd | No | 48.1 - 72.0 | 0 |
| 85 | 23 kV sub-transmission lines (ELD) | Power Supply Line | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 86 | Agawam Village | Elder Housing & Special Needs | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 87 | 23 kV sub-transmission lines (ELD) | Sub-transmission line | Low incidence | No | Dow Reservoir Dam | No | 48.1 - 72.0 | 1 |
| 88 | Sub-transmission line Right-of-Way | Sub-transmission line | Low incidence | No | No | No | 48.1 - 72.0 | 0 |
| 89 | Sewer Trunk Line and Siphon | Sewer | Low incidence | A: 1% Annual Chance; no BFE | No | No | 48.1 - 72.0 | 1 |
| 90 | Sewer Force Main | Wastewater conveyance | Moderate incidence | A: 1% Annual Chance; no BFE | No | No | 48.1 - 72.0 | 1 |
| 91 | Ipswich River: Bay to Green St Bridge | Natural Infrastructure | Moderate incidence | AE: 1% Annual Chance; w/ BFE; VE: High Risk Coastal Area | Water Street | No | 48.1 - 72.0 | 1 |
| 92 | Water Main | Drinking water conveyance | Moderate incidence | A: 1% Annual Chance; no BFE | Island Park Rd/Eagle Hill Rd, Jeffrey's Neck Rd | No | 48.1 - 72.0 | 1 |
| 93 | Clam Flats | Natural Infrastructure | Moderate incidence | AE: 1% Annual Chance; w/ BFE; VE: High Risk Coastal Area | Town Farm Road, Argilla Road, Pavillion Beach, Jeffrey's Neck Road, Island Park Road, Water Street, Little Neck Road, | No | 48.1 - 72.0 | 1 |

## Vulnerability Assessment

The purpose of the vulnerability assessment is to estimate the extent of potential damages from natural hazards of varying types and intensities. A vulnerability assessment and estimation of damages was performed for hurricanes, earthquakes, and flooding. The methodology used for hurricanes and earthquakes was the HAZUS-MH software. The methodology for flooding was developed specifically to address the issue in many of the communities where flooding was not solely related to location within a floodplain.

Introduction to HAZUS-MH

HAZUS- MH (multiple-hazards) is a computer program developed by FEMA to estimate losses due to a variety of natural hazards. The following overview of HAZUS-MH is taken from the FEMA website. For more information on the HAZUS-MH software, go to http://www.fema.gov/plan/prevent/hazus/index.shtm

> "HAZUS-MH is a nationally applicable standardized methodology and software program that contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing and evaluating mitigation plans and policies as well as emergency preparedness, response and recovery planning.
>
> HAZUS-MH uses state-of-the-art geographic information system (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods and earthquakes on populations."

There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data. Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information on the Town of Ipswich, it does not capture all relevant information. In fact, the HAZUS training manual notes that the default data is "subject to a great deal of uncertainty."

However, for the purposes of this plan, the analysis is useful. HAZUS generally indicates the possible extent of damages due to certain types of natural disasters and to allow for a comparison between different types of disasters. Therefore, this analysis should be considered to be a starting point for understanding potential damages from the hazards.

Estimated Damages from Hurricanes

The HAZUS software was used to model potential damages to the community from a 100 year and 500-year hurricane event; storms that are 1% and .0.2% likely to happen in a given year, and roughly equivalent to a Category 2 and Category 4 hurricane. The damages caused by these hypothetical storms were modeled as if the storm track passed directly through the Town, bringing the strongest winds and greatest damage potential.

Though there are no recorded instances of a hurricane equivalent to a 500-year storm passing through Massachusetts, this model was included in order to present a reasonable "worst case scenario" that would help planners and emergency personnel evaluate the impacts of storms that might be more likely in the future, as we enter into a period of more intense and frequent storms.

**Table 28 - Estimated Damages from Hurricanes for Ipswich**

| | **100 Year** | **500 Year** |
|---|---|---|
| **Building Characteristics** | | |
| Estimated total number of buildings | 5,267 | |
| Estimated total building replacement value (2010$) | $2,058 | |
| Millions of dollars | | |
| **Building Damages** | | |
| # of buildings sustaining minor damage | 159 | 880 |
| # of buildings sustaining moderate damage | 13 | 174 |
| # of buildings sustaining severe damage | 0 | 14 |
| # of buildings destroyed | 0 | 10 |
| | | |
| **Population Needs** | | |
| # of households displaced | 0 | 5 |
| # of people seeking public shelter | 0 | 0 |
| | | |
| **Debris** | | |
| Building debris generated (tons) | 630 | 3,460 |
| Tree debris generated (tons) | 1,411 | 3,899 |
| # of truckloads to clear building debris | 25 | 139 |
| | | |
| **Value of Damages (Thousands of dollars)** | | |
| Property damage (buildings and content) | $10,166.31 | $44,721.70 |
| Losses due to business interruption | $428.82 | $3,776.75 |
| Total All Losses | $10,595.13 | $48,498.45 |

Estimated Damages from Earthquakes

The HAZUS earthquake module allows users to define an earthquake magnitude and model the potential damages caused by that earthquake as if its epicenter had been at the geographic center of the study area. For the purposes of this plan, two earthquakes were selected: magnitude 5.0 and a magnitude 7.0. Historically, major earthquakes are rare in New England, though a magnitude 5 event occurred in 1963.

**Table-29**
**Estimated Damages from Earthquakes for Ipswich**

| | **Magnitude 5.0** | **Magnitude 7.0** |
|---|---|---|
| **Building Characteristics** | | |
| Estimated total number of buildings | 5,267 | |
| Estimated total building replacement value (2010 $) Millions of dollars | $2,058 | |
| | | |
| **Building Damages** | | |
| # of buildings sustaining slight damage | 1,525 | 217 |
| # of buildings sustaining moderate damage | 816 | 1,240 |
| # of buildings sustaining extensive damage | 226 | 1,531 |
| # of buildings completely damaged | 57 | 2,261 |
| | | |
| **Population Needs** | | |
| # of households displaced | 228 | 2,908 |
| # of people seeking public shelter | 109 | 1,391 |
| | | |
| **Debris** | | |
| Building debris generated (million tons) | 0.05 | 0.41 |
| # of truckloads to clear debris (@ 25 tons/truck) | 2,120 | 16,560 |
| | | |
| **Value of Damages (Millions of dollars)** | | |
| Property damage (buildings and content) | $238.43 | $1,759.27 |
| Losses due to business interruption | $42.64 | $250.81 |
| Losses related to transportation and utilities | $84.71 | $256.55 |
| Total All Losses | $365.78 | $2,266.63 |

Estimated Damages from Flooding

The HAZUS-MH flood risk module was used to estimate damages to the municipality at the 100 and 500 return periods. These return periods correspond to flooding events that have a 1% and a 0.2% likelihood of occurring in any given year.

**Table-30**
**Estimated Damages from Flooding for Ipswich**

| | 100 Year Flood | 500 Year Flood |
|---|---|---|
| **Building Characteristics** | | |
| bEstimated total number of buildings | 5,267 | |
| Estimated total building replacement value (2010 $) Millions of dollars | $2,058 | |
| | | |
| **Building Damages** | | |
| # of buildings sustaining slight damage | 6 | 3 |
| # of buildings sustaining moderate damage | 30 | 36 |
| # of buildings sustaining substantial damage | 10 | 25 |
| # of buildings completely damaged | 2 | 25 |
| | | |
| **Value of Damages (millions of dollars)** | | |
| Property damage (buildings and content) | $28.99 | $72.80 |
| Losses due to business interruption | $10.74 | $22.08 |
| Total All Losses | $39.73 | $84.88 |
| | | |
| **Population Needs** | | |
| # of households displaced | 138 | 232 |
| # of people seeking public shelter | 13 | 26 |
| | | |

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# V. HAZARD MITIGATION GOALS

The Ipswich Local Multiple Hazard Community Planning Team met on March 27, 2018. At that meeting, the team reviewed and discussed the set of goals and objectives for the town of Ipswich. The team endorsed the following nine goals for the Ipswich Hazard Mitigation Plan 2018 Update:

1. Prevent and reduce the loss of life, injury, public health impacts and property damages resulting from all major natural hazards.

2. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.

3. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees and boards.

4. Prevent and reduce the damage to public infrastructure resulting from all hazards.

5. Encourage the business community, major institutions and non-profits to work with the Town to develop, review and implement the hazard mitigation plan.

6. Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.

7. Ensure that future development meets federal, state and local standards for preventing and reducing the impacts of natural hazards.

8. Take maximum advantage of resources from FEMA and MEMA to educate Town staff and the public about hazard mitigation.

9. Consider the potential impacts of climate change and incorporate climate mitigation and resilience in all planning efforts.

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# VI. EXISTING MITIGATION MEASURES

The existing protections in the Town of Ipswich are a combination of zoning, land use, and environmental regulations, infrastructure maintenance and drainage infrastructure improvement projects. Infrastructure maintenance generally addresses localized drainage clogging problems, while large scale capacity problems may require pipe replacement or invert elevation modifications.

The Town's existing mitigation measures are listed by hazard type here and are summarized in Table 31 below.

Flooding – Existing Town-wide mitigation

Ipswich employs a number of practices to help minimize potential flooding and impacts from flooding, and to maintain existing drainage infrastructure. Existing Town-wide mitigation measures include the following:

*National Flood Insurance Program (NFIP)*--Ipswich participates in the NFIP with 112 policies in force as of the September 30, 2018. FEMA maintains a database on flood insurance policies and claims. This database can be found on the FEMA website at https://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13

The following information is provided for the Town of Ipswich:

| | |
|---|---|
| Flood insurance policies in force (as of September 30, 2018) | 112 |
| Coverage amount of flood insurance policies | $ 30,765,000 |
| Premiums paid | $144,291 |
| Total losses (all losses submitted regardless of the status) | 41 |
| Closed losses (Losses that have been paid) | 29 |
| Open losses (Losses that have not been paid in full) | 0 |
| CWOP losses (Losses that have been closed without payment) | 12 |
| Total payments (Total amount paid on losses) | $402,369.88 |

The Town complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements.

*Massachusetts State Building Code* – The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing, and snow loads. The Town has adopted the state building code.

*Street sweeping* – Every street gets swept once a year or as needed. Street sweeping is contracted out.

*Catch basin cleaning* – All of the town's approximately 1200 catch basins are cleaned out once a year. This service is contracted out.

Roadway treatments – The town uses a 50/50 mixture of sand and salt.

Subdivision Rules and Regulations – The subdivision rules and regulations contain a number of requirements that address flood hazard mitigation. Some of these provisions also relate to other hazards.

Subdivision Rules Section VI: Subdivision Requirements for Improvement and Design

6.1 General Requirements include provisions to "avoid problems associated with uncontrolled stormwater runoff."

6.2.1 Protection of Natural Features: includes language for "due regard for natural features such as watercourses… aquifers and floodplains."

6.2.2 Unsuitable Land: The Planning Board has discretion not to allow subdivision of land due to "flooding, improper or adverse drainage."

6.3 Lot Arrangement: Lots must be arranged so that "no foreseeable difficulties occur due to topography, soils, or improper drainage."

6.3.3 Lots must comply with town rules and regulations governing soil erosion and sediment control in Appendix IX.

6.3.4 Lot Drainage: Drainage must be designed to run away from all proposed buildings, adjacent lots and street(s).

6.14 Storm Drainage General: Stormwater to be managed through storage and controlled release, designed for 100- year storm capacity and, with an emphasis on conserving natural drainage patterns; rules apply to all subdivisions, multifamily and site plan review applications. Stormwater Management Report required, see Appendix VIII below.

6.14.1 Peak Flows not to exceed pre-construction levels; maximize on-site runoff retention, and minimize overland runoff to adjacent lots, streets and watercourses.

6.14.6 Natural drainage patterns to be used wherever possible and existing watercourses to be left open.

6.14.8 Structured drainage systems may be used if soil and topography make natural drainage patterns impractical and if adjacent street storm drains have the capacity to absorb new stormwater flows.

Appendix II Surface Water Drainage Installation and Specifications

5. Approved cross drains with 100-year storm event capacity to be installed when natural drainage systems are altered.

6. No connection of foundation drains or roof leader drains to street drain systems are allowed.

Appendix VIII Stormwater Rules and Regulations: Requires Storm Water Management Report: The Stormwater Management Report submitted must demonstrate that the

proposed development or activity has been planned and designed and will be constructed and maintained to meet each of the following standards:

a. ensure that after development that no detrimental effects shall be created or caused by the proposed development;
b. maintain the natural hydrodynamic characteristics of the watershed;
c. protect or improve the quality of surface and ground waters;
d. protect, maintain, or improve water quality or existing water quality standards for all receiving waters, water courses and water bodies;
e. protect and maintain groundwater levels;
f. protect the beneficial functioning of wetlands as areas for natural storage of floodwaters, the chemical reduction and assimilation of pollutants and wildlife and fisheries habitat;
g. prevent increased flooding and damage that results from improper location, construction and design of structures;
h. prevent reverse salt water intrusion;
i. protect the natural fluctuating levels of salinity in estuarine areas;
j. minimize alteration to flora and fauna and adverse impacts to fish and wildlife habitat;
k. otherwise further the objectives of the Stormwater Management Policies and Regulations.

*Zoning Regulations*

***IX. C. Water Supply Protection District***

Purpose of District. The purpose of this Water Supply Protection District is to:
a. promote the health, safety, and general welfare of the community by ensuring high quality and safe drinking water for the residents, institutions, and businesses of the Town of Ipswich; and
b. preserve and protect existing and potential sources of drinking water supplies.
The Water Supply Protection District is divided into three districts- Zone A, Zone II and Zone C. Certain uses are prohibited in the districts and some require a special permit from the Planning Board. Increasing the impervious area of a lot beyond 15% without providing a means or stormwater recharge or 20% if an acceptable means of recharge is provided, requires a special permit from the Planning Board.

***IX. D. Floodplain District***

**1.** Purpose: The purposes of the Floodplain District are to:
a. Ensure public safety through reducing the threats to life and personal injury;
b. Eliminate new hazards to emergency response officials;
c. Prevent the occurrence of public emergencies resulting from water quality, contamination, and pollution due to flooding;
d. Avoid the loss of utility services, which if damaged by flooding would disrupt or shutdown the utility network and impact regions of the community beyond the site of flooding;

e. Eliminate costs associated with the response and cleanup of flooding conditions;

f. Reduce damage to public and private property resulting from flooding waters.

**2.** Applicability

The Floodplain District is established as an overlay district to all other zoning districts.

All development in the district, including structural and non-structural activities, whether permitted by right or by special permit, must be in compliance with Chapter 131, Section 40 of the Massachusetts General Laws and with the following:

Section of the Massachusetts State Building Code which addresses floodplain and coastal high hazard areas (780 CMR 3107.0, "Flood Resistant Construction");

h

Wetlands Protection Regulations, Department of Environmental Protection (DEP) (as of August1, 1997, 310 CMR 10.00);

Inland Wetlands Restriction, DEP (as of August 1, 1997, 302 CMR 6.00);

Coastal Wetlands Restriction (as of August 1, 1997, 302 CMR 4.00);

Minimum requirements for the Subsurface Disposal of Sanitary Sewage (as of August 1, 1997, 310 CMR 15, Title 5);

Any variances from the provisions and requirements of the above-referenced state regulations may only be granted in accordance with the required procedures of these state regulations.

**3.** Development Requirements: The following additional development requirements apply in the Flood Plain District:

a. Within Zone A, where the base flood elevation is not provided on the Town of Ipswich

Compiled Flood Insurance Rate Map, the applicant shall obtain any existing base flood elevation data, and it shall be reviewed by the Building Inspector for its reasonable utilization toward meeting the elevation or flood proofing requirements, as appropriate, of the State Building Code.

b. Located within the Flood Plain District are areas designated as coastal high hazard areas (Zone V). As these areas are extremely hazardous due to high velocity waters from tidal surges and hurricane wave wash, all new construction shall be located landward of the reach of the mean high tide.

c. In the Floodway, designated on the Town of Ipswich Flood Boundary and Floodway Map: (1) All encroachments, including fill, new construction, substantial improvements to existing structures, and other developments are prohibited. If the Zoning Board of Appeals finds that any of the above will not result in any increase in flood levels during the occurrence of the 100 year flood, the Zoning Board of Appeals may allow

such by special permit. (2) Any encroachment meeting the above standard shall comply with all flood plain requirements of the State Building Code.

d. In the AO zones, the lowest floor of new construction of substantial improvements shall be elevated above the crown of the nearest street or above the depth number indicated on the Town of Ipswich Flood Boundary and Floodway Map.

e. Incorporated herein by reference are the following: The Flood Insurance Study, Town of Ipswich, Massachusetts, prepared by the Federal Emergency Management Agency, February 5, 1985, on file in the office of the Town Clerk; the Flood Insurance Rate Maps, dated August 5, 1985, and revised July 2, 1992, and the Flood Boundary and Floodway maps, dated August 5, 1985, on file in the office of the Department of Planning & Development.

f. In Zone A, A1-A30, and AE, along watercourses that have not had a regulatory floodway designated, the best available Federal, State, local, or other floodway data shall be used to prohibit encroachments in floodways which would result in any increase in flood levels within Ipswich during the occurrence of the base flood discharge

g. Base flood elevation data is required for subdivision proposals or other developments greater than 50 lots or five acres, whichever is the lesser, within unnumbered A zones.

h. Within Zones AH and AO on the Flood Insurance Rate Map (FIRM), adequate drainage paths around structures on slopes will be required to guide floodwaters around and away from proposed structures. (Added by 10/18/99 Special Town Meeting; approved by Attorney General 1/5/00)

i. Man-made alteration of sand dunes within Zones V1-V30, VE, and V which would increase potential flood damage is expressly prohibited.

j. All subdivision proposals, regardless of zone, will be reviewed to assure that: a) such proposals minimize flood damage; b) all public utilities and facilities are located and constructed to minimize or eliminate flood damage; and c) adequate drainage is provided to reduce exposure to flood hazards.

***O. Green Space Preservation District***

An overlay district in low density residential areas, the GSPD allows limited development of office, research and development uses and large lot residential housing while requiring that at least 50% of the lot area for the development remain as publicly accessible open space.

***X. Site Plan Review***

Site Plan Review applies to:

1) construction of any new community facility, commercial, industrial or business building; or any additions or alterations in excess of 2,500 square feet or thirty percent (30%) of the existing gross floor area, whichever is less, which has been constructed within the consecutive two-year period;

2. Construction of any drive-through facility;

3. Any change or intensification of use which increases the parking requirement by ten spaces and/or triggers the requirement of a new loading zone; and

4. Grading, clearing, or other non-residential land development activity except for the following: work incidental to agricultural activities; clearing necessary for percolation and other site tests; or work in conjunction with an earth removal permit.

The stormwater rules and regulations in Appendix VIII apply to all site plan review applications.

*Stormwater Bylaw*
The town adopted a Stormwater Bylaw in October of 2008. A Stormwater Permit is required for all projects that disturb more than 10,000 square feet of land or more than 50% of the parcel area, whichever is less. The bylaw also requires that a permit must also be obtained before any direct connection or discharge into the town's storm drain system is allowed. Regulations for the bylaw were adopted in 2010.

*Wetlands Protection Bylaw:* The Ipswich Wetlands Protection Bylaw includes jurisdiction of a 150' buffer landward of the Great Marsh Area of Critical Environmental Concern (ACEC), as well as a 50' No-disturbance Zone and additional 15' No-Build Zone. This NDZ is reduced to 25' in previously developed properties where there is no change in use. The Bylaw was amended on October 27, 2015 to better define resource areas, correct errors, clarify submittal requirements, and remove the automatic exemptions in the WPA regulations for minor projects. These project s are now approvable under a Small Projects Permit. The local regulations were amended in February 2016 to make regulations consistent with the Bylaw changes; March 1, 2017 for requirements for monitoring of permitted work, and January 17, 2018 for fee increases, and changes of submittal permit application requirements

Dams—Existing Mitigation Measures

Information on dam issues was gathered from the Local Hazard Mitigation Team and town publications**.** The town is in the process of evaluating its largest dam, the Ipswich Mills Dam (formerly Sylvania Dam) and repairing the Dow Reservoir Dam.

**Ipswich Mills Dam:** The Town is conducting the Ipswich Mills Dam Removal Feasibility Study. The study will evaluate the cost, impacts, and feasibility of removing the dam The study will look at three main issues: 1) How the dam affects flooding; 2) The dam's impact on the nearby EBSCO Publishing Company, housed in a former mill building adjacent to the river; 3) Whether contaminated sediments have been trapped upstream from the dam.

**Dow Reservoir Dam:** this dam is owned by the Ipswich Utilities Department, and impounds Dow Brook Reservoir, which is part of the town's public water supply. Construction was completed in 1890 and the dam is of earthen construction, 330 feet in length. After seepage was detected in April 2018, the water level in the reservoir was lowered and in June 2018 the Town began a project to repair the dam.

Flooding – Existing Mitigation Measures

The Town has completed several drainage upgrades to reduce flood risk:

- Elevated of a low-lying section of County Road
- Replaced a culvert and elevated a low section of Old Right Road
- Increased municipal drainage preventative measures
- Increased manpower available to DPW and Fire Departments prior to and during flooding emergencies

Existing Wind Hazard Mitigation Measures

*Massachusetts State Building Code* – The town enforces the Massachusetts State Building Code whose provisions are generally adequate to protect against most wind damage. The code's provisions are the most cost-effective mitigation measure against tornados given the extremely low probability of occurrence. If a tornado were to occur, the potential for severe damages would be extremely high.

*Power Supply Right-of-Way Maintenance* - Ipswich Electric Light Dept. conducts periodic brush mowing and boundary clearing for threat removal, infrastructure repair and risk assessment. Line monitoring is performed by hiking through thick brush (2.5 miles roundtrip). The area is approximately 14 acres, spanning 1.25 miles from 272 High Street to Ipswich/Rowley town line. It is heavily wooded on either side of 100-foot right-of-way, with thick brush and several wetland areas, and is in close proximity to public water supply (Dow Brook Reservoir). Dual, 23kV, sub-transmission supply lines run parallel through the right-of-way to deliver sole power supply to the Town. ELD recommends improve access by developing unpaved road/trail to be accessed by 4x4 vehicle.

Existing Winter Hazard Mitigation Measures

*Snow removal and disposal* –The town conducts general snow removal operations with its own equipment and hires outside contractors as needed.
The Mass Department of Transportation (MA DOT) handles snow removal for portions of State Highway Routes 1, 1A and 133 in Ipswich.

*Tree-trimming program* –In addition to mitigating wind impacts, the town's tree trimming program also helps to mitigate fallen trees and branches due to snow and ice storms, which may also reduce local power outages.

Existing Brush Fire Hazard Mitigation Measures

*Permits Required for Outdoor Burning* – The Fire Department requires a written permit for outdoor burning, which is permitted only between January 15 and April 30.
Existing Geologic Hazard Mitigation Measures

*Massachusetts State Building Code* – The State Building Code, updated in 2010, contains a section on designing for earthquake loads (780 CMR 1612.0). Section 1612.1 states that the purpose of these provisions is "to minimize the hazard to life to occupants of all buildings and non-building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake". This section goes on to state that due to the complexity of seismic design, the criteria presented are the minimum considered to be "prudent and economically justified" for the protection of life safety. The code also states that absolute safety and prevention of damage, even in an earthquake event with a reasonable probability of occurrence, cannot be achieved economically for most buildings.

Section 1612.2.5 sets up seismic hazard exposure groups and assigns all buildings to one of these groups according to Table 1612.2.5. Group II includes buildings which have a substantial public hazard due to occupancy or use and Group III are those buildings having essential facilities which are required for post-earthquake recovery, including fire, rescue and police stations, emergency rooms, power-generating facilities, and communications facilities.

Existing Multihazard Mitigation

Following are several mitigation measures that impact more than one hazard.

***Comprehensive Emergency Management Plan (CEMP)*** – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. These plans address mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. These plans contain important information regarding flooding, dam failures and winter storms. Therefore, the CEMP is a mitigation measure that is relevant to many of the hazards discussed in this plan.

***Enforcement of the State Building Code*** – The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing and snow loads.b

***Participation in the a regional emergency committee--***Ipswich is a member of the Cape Ann Emergency Committee.

***Limited back-up power supply (9MW)*** is available for regional grid support and local islanding of critical infrastructure when transmission service is unavailable. Electric Light Dept. conducts annual engine refurbishment and auxiliary equipment redesign to support ISO-NE, DEP and EPA requirements. ELD is developing standard operating procedures to provide guidance on when and how to conduct islanding operations. Several improvements are recommended in the Mitigation Measures listed in Section VII.

***Security at Electric Light Dept. facilities--*** Security is performed with limited amount of motion-detection alarms in substations and power plant. Facilities have gates and doors with manual locks. Sites include three electric substations, sub-transmission lines and associated right-of-ways, business office, vehicle garage, storage facility, and power plant. Additional assets on site include public water supply (Dow Brook and Bull Brook Reservoirs and Dams), Water Treatment Plant, and Waste Water Treatment Plant. Several improvements are recommended in the Mitigation Measures in Section VII.

***The Town has several important emergency management resources:***

A) The Ipswich Fire Dept. is part of the Statewide Fire Mobilization Structural Task Force
B) The Ipswich Fire Dept. is part of the Statewide Fire Mobilization Forestry Task Force
C) The Ipswich Fire Dept. is part of the Massachusetts Mutual Aid Fire District 5
D) The Town utilizes the MA Emergency Incident Command Unit
E) The town has Smart 911
F) Ipswich is a member of the Region One Boston Network
G) The Town Hall and the High School have generators

The Town's existing mitigation measures are summarized in Table 31 below.

**Table 31- Summary of Existing Hazard Mitigation Measures**

| Hazard | Area | Mitigation Measures | Effectiveness |
|---|---|---|---|
| **Flood – Related** | Town-Wide | A) The town participates in the National Flood Insurance Program and adopted the FIRM maps. There are 72 policies in force. The town actively enforces floodplain regulations. | Effective, the town has 112 flood policies in force. |
| | | B) All streets and catch basins (1200) are cleaned annually. | Effective; may need to be modified to comply with MS4 stormwater permit |
| | | C) Sand/salt mix is used for winter road treatments. | |
| | | D) Drainage infrastructure and maintenance performed using MA Chapter 90 funds. | |
| | | E) Subdivision Rules for drainage, stormwater runoff; Stormwater Management Report required. | Effective; may need to be modified for MS4 permit |
| | | F) Flood Plain Overlay District | |
| | | G) Site Plan Review for stormwater and erosion | Effective |
| | | H) Stormwater and Illegal Discharge Bylaw | Effective; amended in 2017 for MS4 |

| Hazard | Area | Mitigation Measures | Effectiveness |
|---|---|---|---|
| | | I) Green Space Preservation District<br>J) Wetlands Protection Bylaw/Regs<br>K) Green Ring Open Space Initiative<br>L) Open Space Plan<br>M) Hazardous and Toxic Materials Bylaw<br>N) MEMA statewide mutual aid compact for DPW and other town services | <br>Updated 2015-17<br><br>Updated 2013<br>Effective<br><br>Effective |
| **Dams** | **Town-Wide** | A) DCR Dam Safety Regulations<br>B) State permits required for dam construction.<br>C) The Comprehensive Emergency Management Plan addresses dams.<br>D) Evaluation of Ipswich Mills Dam<br>E) Evaluation of Dow Reservoir Dam | Effective<br>Effective<br><br>Effective<br><br>Effective<br>Effective; Dam repairs planned |
| **Wind-Related** | **Town-Wide** | A) The Ipswich Electric Light Dept. performs tree maintenance of power line Rights of Way.<br>B) The town enforces the MA State Building Code. | Improvements to increase access needed<br>Effective |
| **Winter-Related** | **Town-Wide** | A) Standard snow removal operations; road treatment with salt/sand mix.<br>B) The Town performs its own tree maintenance. | Effective<br><br>Effective |
| **Brush Fire-Related** | **Town-Wide** | A) The Fire Department requires a written permit for outdoor burning. | Effective |
| **Geologic - Earthquake** | **Town-Wide** | A) The town enforces the MA State Building Code.<br>B) Evacuation plans in CEMP | Effective<br><br>Effective |
| **Geologic-Landslide** | **Town-Wide** | A) Maximum slope for subdivision roads | Effective |
| **Multi-Hazard** | **Town-Wide** | A) The town enforces the MA State Building Code.<br>B) Ipswich has a Comprehensive Emergency Plan<br>C) Town utilizes the MA Emergency Incident Command Unit.<br>D) Town has Smart 911, a form of Reverse 911.<br>E) Ipswich is a member of the Region | Effective<br><br>Effective; needs to be periodically updated<br><br>Effective<br><br>Effective |

| Hazard | Area | Mitigation Measures | Effectiveness |
|---|---|---|---|
| | | One Boston Network (BAPERN).<br>F) The town is a member of the Cape Ann Emergency Committee.<br>G) The Town Hall and High School (Emergency Shelter) have generators.<br>H) Ipswich Electric Light Dept. maintains a 9MW power station with limited capability to provide islanding<br>I) Site Security for ELD facilities<br>J) The Ipswich Fire Dept. is part of the Statewide Fire Mobilization Structural Task Force<br>K) The Ipswich Fire Dept. is part of the Statewide Fire Mobilization Forestry Task Force<br>L) The Ipswich Fire Dept. is part of the Massachusetts Mutual Aid Fire District 5 | <br>Effective<br><br>Need a Town-wide generator plan<br>Improvements recommended by ELD<br>Upgrades needed<br>Effective<br><br><br>Effective<br><br><br>Effective |

**Local Capacity for Implementation**

Under the Massachusetts system of "Home Rule," the Town of Ipswich is authorized to adopt and from time to time amend a number of local bylaws and regulations that support the town's capabilities to mitigate natural hazards. These include Zoning Bylaws, Subdivision and Site Plan Review Regulations, Wetlands Bylaws, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local Bylaws may be amended each year at the annual Town Meeting to improve the town's capabilities, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission, such as the Planning Board or Conservation Commission.

The Town of Ipswich has recognized several existing mitigation measures that require implementation or improvements, and has the capacity within its local boards and departments to address these. The Ipswich Department of Public Works will address the needs for catch basin cleaning, repairs and upgrades to culverts and other drainage infrastructure. The Planning Board will address the updates to the Master Plan and implementation of the Zoning Ordinance, Floodplain District, and Subdivision Rules and Regulations. The Conservation Commission will oversee implementation of the Wetlands Bylaw and the Open Space Plan. The Department of Public Works together with the Planning Board and Conservation Commission will coordinate implementation and enforcement of the Stormwater Bylaw.

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# VII. MITIGATION MEASURES FROM THE 2012 PLAN

### Implementation Status of the Previous Plan

At a meeting of the Ipswich Hazard Mitigation Planning Team, Town staff reviewed the mitigation measures identified in the 2012 Ipswich Hazard Mitigation Plan and determined whether each measure had been implemented or deferred. Of those measures that had been deferred, the committee evaluated whether the measure should be deleted or carried forward into this Hazard Mitigation Plan 2018 Update. The decision on whether to delete or retain a particular measure was based on the team's assessment of the continued relevance or effectiveness of the measure and whether the deferral of action on the measure was due to the inability of the Town to take action on the measure. Table 32 summarizes the status of mitigation measures from the 2012 plan that are being continued in this 2018 plan update.

Ipswich has made progress on implementing mitigation measures identified in the 2012 Hazard Mitigation Plan, including:

- Elevated of a low-lying section of County Road
- Replaced a culvert and elevated a low section of Old Right Road
- Increased municipal drainage preventative measures
- Increased manpower available to DPW and Fire Departments prior to and during flooding emergencies
- A guidance document on Beavers was created by the Conservation Agent. It discusses how to navigate the complicated permitting process for dealing with impacts from beavers and muskrats. This document has been uploaded to the Conservation Office's website.
- The Wetlands Bylaw Rules, as well as associated Rules and Regulations were updated to make them more consistent with each other, and the Commission's policies and priorities for protecting wetlands, as well as to standardize permitting requirements. The Conservation Office is also in the process of a multi-year effort to ensure that all Orders of Conditions are properly closed out with Certificates of Compliance, and that all past Enforcement Orders are closed out. On the staffing side, although the office has 1.5 more hours/week of Administrative Assistant support (now 21 hours/week), and a part-time field inspector has been hired (10-12 hours/week), additional staff time is still needed.
- The Town acquired two portable, 2.5-inch multi-fuel pumps
- The town developed a portable command communications center
- The Town upgraded all fire road emergency access gates and installed a universal key system
- The Town incorporated outfalls and catch basins into GIS database
- National Flood Insurance (NFIP) In July 2014 responsibility of the FEMA NFIP maps was handed over to the Conservation Agent. The Agent attended a 3-day FEMA training session in 2015 to learn how to interpret these maps. NFIP maps

still need to be uploaded on to the website, but may be viewed in the Conservation Office. The Agent also assists citizen's in viewing and printing FEMA maps on line. It is recommended that a Floodplain Manager should formally designated. The Building Inspector currently serves informally in this role. In addition, a process should be established to ensure that elevation certificates are provided by building permit applicants as required for work in high hazard flood areas. The Town should consider joining the Community Rating System program. Regarding stormwater and wetlands, a 2016 CZM Coastal Resilience Grant resulted in: posting two educational signs along the Ipswich River (one regarding the fragility of plants on coastal bank, and the other about stormwater management), assessment of coastal bank erosion along the Ipswich River, and the prohibition of storing boats on salt marsh and coastal bank, which had been damaging vegetation. The town plans to apply for additional grant funding to continue the costal resiliency work. Finally, the Town is looking in to applying for FEMA's Community Rating System program.

Overall, 17 mitigation measures from the 2012 plan will be carried forward in this 2018 plan update.

Moving forward into the next five year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the Town's decision making processes. The challenges the Town faces in implementing these measures are primarily due to limited funding and available staff time. This plan should help the Town prioritize the best use of its limited resources for enhanced mitigation of natural hazards.

## Table 32- Mitigation Measures from the 2012 Plan

| Hazard Area/Type | Mitigation Measure in 2012 Plan | Priority in 2012 Plan | 2018 Status Completed / In Progress / Not Completed | Include in 2018 Update? 2018 Priority? |
|---|---|---|---|---|
| High Priority | | | | |
| *Jeffrey's Neck Road* | A) Elevate the two low-lying sections of the road that flood during coastal storm surge events and isolates 1200 (winter) residents in about 600 homes. Includes Island Park Road. | High | In Progress:<br>Currently applied for FEMA grant.<br>30 percent design is done | YES - High |
| *Labor in Vain Road* | B) Replace existing stone, 4 x 4 culvert with larger pre-cast concrete culvert. | High | Not Completed | YES - High |
| *Flooding at 110 -112 County Road/Route 1A, (MassDOT) and 12-14 Heartbreak Road and southern end of Heartbreak Rd (Town)* | C) Drainage study of affected areas. | High | Not Completed | YES - High |
| *Pine Swamp Road culverts* | D) Replace existing 18-inch corrugated culverts with 30-40-inch precast concrete culverts and elevate low section in road. | High | Not Completed | YES - High |
| *Beaver-related flooding issues* | E) Creation of an effective flow management and dam alteration policy | High | Completed: Guidance on beavers done by Conservation Agent | NO |
| *Flooding* | F) Purchase two portable, 2.5-inch multi-fuel pumps. | High | Completed | NO |

| **Hazard Area/Type** | **Mitigation Measure in 2012 Plan** | **Priority in 2012 Plan** | **2018 Status Completed / In Progress / Not Completed** | **Include in 2018 Update? 2018 Priority?** |
|---|---|---|---|---|
| *Land Protection* | G) Ongoing protection and acquisition of open space parcels. | High | In Progress | YES – Med |
| *Land Protection* | H) Update Wetland Bylaw regulations. | High | In Progress: Wetlands regulations updated in 2015-2017. Need more administrative support for implementation. | YES – Med |
| *High Winds and Hurricanes* | I) Work with the Ipswich municipal Electric Company to create an effective and ongoing tree management program. | High | In Progress<br>6 weeks done by Forestry Department<br>12 weeks done by contractor | YES-High |
| *Multi-hazard: power outage and communications* | J) Purchase six mobile, 2500 Kw multi-fuel generators | High | Not Completed<br><br>Combine items (J), (g), (L) and (CC) into a single new mitigation measure:<br>"Develop and implement a Town-wide generator plan" | YES-High<br><br>Revise and combine these 3 items into town wide plan for generators |
| *Multi-hazard: power outage and communications* | K) Purchase two mobile, 5500 Kw multi-fuel generators for use by Emergency Management needs. | High | | |
| *Multi-hazard: power outage and communications* | L) Provide one fixed, 10,000 Kw for Department of Public Works facility and garage. | High | | |
| *Multi-hazard: power outage and communications* | M) Create a portable command communications center. | High | Completed | NO |

| **Hazard Area/Type** | **Mitigation Measure in 2012 Plan** | **Priority in 2012 Plan** | **2018 Status Completed / In Progress / Not Completed** | **Include in 2018 Update? 2018 Priority?** |
|---|---|---|---|---|
| *Multi-hazard: power outage and communications* | N) Update or replace existing Incident Command Center. | High | Not Completed | YES-High |
| Medium Priority | | | | |
| *187 County Road* | O) Elevate low-lying road section. | Medium | Completed (MassDOT) | NO |
| *Old Right Road (west of Plains Road)* | P) Replace culvert and elevate low section in road. | Medium | Completed | NO |
| *Drainage Infrastructure* | Q) Increase municipal drainage preventive maintenance practices. | Medium | Completed | NO |
| *Drainage Infrastructure* | R) Increase manpower available to DPW and Fire Departments prior to and during flooding emergencies. | Medium | Completed | NO |
| *Ipswich Mills Dam* | S) Complete feasibility study and analyze options for dam removal. | Medium | In Progress:<br>Under review: evaluating EBSCO structure and developing dam removal scenario renderings. | YES-Low |
| *Flooding/NFIP* | T) Public Information on NFIP Compliance, Stormwater, and Wetlands | Medium | In Progress:<br>FEMA maps kept by the Conservation Commission. Building Department is the Flood Plain Manager | YES-Med |

| **Hazard Area/Type** | **Mitigation Measure in 2012 Plan** | **Priority in 2012 Plan** | **2018 Status Completed / In Progress / Not Completed** | **Include in 2018 Update? 2018 Priority?** |
|---|---|---|---|---|
| *Brush Fires* | U) New protective brush fire gear. | Medium | Not Completed | YES-Med |
| *Brush Fires* | V) Upgrade all fire road emergency access gates and install a universal key system. (state gates)BB | Medium | Completed | NO |
| Low Priority | | | | |
| *Flooding and Drainage* | W) Upgrade Linebrook Road culverts. | Low | Not Completed:<br>Half of culvert repaired following Mother's Day storm. Permanent upgrade needed. | YES-High |
| *Flooding and Drainage: tidal surge* | X) Town Farm Road: elevate 75 – 100-foot section of low section of road. | Low | Not Completed | YES-Med |
| *Flooding and Drainage* | Y) Water Street | Low | Not Completed | YES-Med |
| *Flooding and Drainage* | Z) Incorporate outfalls and catch basins into GIS database. | Low | Completed | NO |
| *Earthquakes* | AA) Investigate options to make all public safety buildings earth-quake resistant. | Low | Not Completed | YES-Low |
| *Multi-hazard: power outage and communications* | BB) Ensure that emergency plans for hazardous facilities within Ipswich are up to date and mapped. | Low | Not Completed | NO |
| *Multi-hazard: power outage and communications* | CC) Upgrade all fixed generators as needed, provide alternative fuel sources. | Low | NOT Completed<br>Revise and combine with items J/K/L – Town wide generator plan | YES-High |

# VIII. HAZARD MITIGATION STRATEGY

### What is Hazard Mitigation?

Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, education programs, infrastructure projects and other activities. FEMA currently has three mitigation grant programs: the Hazards Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation program (PDM), and the Flood Mitigation Assistance (FMA) program. The three links below provide additional information on these programs.

http://www.fema.gov/government/grant/hmgp/index.shtm
http://www.fema.gov/government/grant/pdm/index.shtm
http://www.fema.gov/government/grant/fma/index.shtm

Hazard Mitigation Measures can generally be sorted into the following groups:

- Prevention: Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.
- Property Protection: Actions that involve the modification of existing buildings or infrastructure to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and shatter resistant glass.
- Public Education & Awareness: Actions to inform and educate citizens, elected officials, and property owners about the potential risks from hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- Natural Resource Protection: Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- Structural Projects: Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include storm water controls (e.g., culverts), floodwalls, seawalls, retaining walls, and safe rooms.
- Emergency Services Protection: Actions that will protect emergency services before, during, and immediately after an occurrence. Examples of these actions include protection of warning system capability, protection of critical facilities, and protection of emergency response infrastructure.
  (Source: *FEMA Local Multi-Hazard Mitigation Planning Guidance*)

Regional and Inter-Community Considerations

Some hazard mitigation issues are strictly local. The problem originates primarily within the municipality and can be solved at the municipal level. Other issues are inter-community issues that involve cooperation between two or more municipalities. There is a third level of mitigation which is regional; involving a state, regional or federal agency or an issue that involves three or more municipalities.

Regional Partners

Mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are a complex system of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including but not limited to the Town of Ipswich, the Department of Conservation and Recreation (DCR), Massachusetts Department of Transportation (MassDOT) and the Massachusetts Bay Transportation Authority (MBTA). The planning, construction, operations and maintenance of regional facilities and infrastructure are integral to the flood hazard mitigation efforts of communities. These agencies must be considered regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do including budgetary and staffing constraints and numerous competing priorities. Implementation of mitigation measures will require that all parties work together.

Major facilities and resources downed, operated and maintained by federal, state, regional or private entities in Ipswich include:

- Massachusetts Routes 1, 1A, and 133 (MassDOT)
- MBTA Commuter Rail (station in Ipswich Town Center)
- Crane Beach and Castle Hill (Trustees of Reservations)
- Parker River National Wildlife Reserve (Plum Island)
- Ipswich River Wildlife Reservation (Mass Audubon Society)
- Bradley Palmer State Park (DCR)
- Willowdale State Forest (DCR)
- Great Marsh (shared with the Towns of Essex, Rowley, Newbury, and Newburyport)

**Process for Setting Priorities for Mitigation Measures**

The last step in developing Ipswich's mitigation strategy was to assign a level of priority to each mitigation measure so as to guide the focus of the Town's limited resources towards those actions with the greatest potential benefit. At this stage in the process, the Local Hazard Mitigation Planning Team had limited access to detailed analyses of the cost and benefits of any given mitigation measure, so prioritization is based on their understanding of existing and potential hazard impacts and an approximate sense of the costs associated with pursuing any given mitigation measure.

Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events, the extent of the area impacted, and the relation of a given mitigation measure to the Town's goals. In addition, the town also took into consideration factors such as the extent of the area affected, whether or not road closures were involved, and what impact they would had on delivery of emergency services and the local economy, anticipated project costs, whether any environmental constraints existed, and whether the Town would be able to justify the costs relative to the anticipated benefits.

Table 33 below demonstrates the prioritization of the Town's potential hazard mitigation measures. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of the following criteria:

| **Estimated Benefits** | |
|---|---|
| High | Action will result in a significant reduction of hazard risk to people and/or property from a hazard event |
| Medium | Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event |
| Low | Action will result in a low reduction of hazard risk to people and/or property from a hazard event |
| **Estimated Costs** | |
| High | Estimated costs greater than $100,000 |
| Medium | Estimated costs between $10,000 to $100,000 |
| Low | Estimated costs less than $10,000 and/or staff time |
| **Priority** | |
| High | Action very likely to have political and public support and necessary maintenance can occur following the project, and the costs seem reasonable considering likely benefits from the measure |
| Medium | Action may have political and public support and necessary maintenance has potential to occur following the project |
| Low | Not clear if action has political and public support and not certain that necessary maintenance can occur following the project |

**Table 33: Mitigation Measure Prioritization**

| Mitigation Measure | Geographic Coverage | Estimate Cost | Estimated Benefit | 2018 Priority |
|---|---|---|---|---|
| **Flooding** | | | | |
| 1) Drainage study of affected areas (3 culverts have been replaced to date) | *County Road/ Route 1A, Heartbreak Rd Heartbreak Rd* | High | High | High |
| 2) Replace existing 18-inch corrugated culverts with 30-40-inch precast concrete culverts and elevate low section in road. | *Pine Swamp Road* | Medium | High | High |
| 3) Upgrade Linebrook Road culverts – replace at Bull Brook | *Linebrook Road* | High | High | High |
| 4) Replace/rehabilitate piping; protect by armoring line | *Sewer trunk line along the Ipswich River, and siphon under the River* | High | High | High |
| 5) Replace culvert with structure based on design that is more resilient to erosion and meets the Mass. Stream Crossing standards | *Topsfield Road* | High | High | High |
| 6) Elevate 75 – 100-foot section of low section of Town Farm Road and increase culvert size i | *Town Farm Road* | High | Medium | Medium |
| 7) Stormwater improvements and coastal bank stabilization needed at the end of Summer St. | *Water Street* | Medium | Medium | Medium |
| 8) Undercutting of coastal bank below Water Street must be addressed as the road and electric utilities are threatened. | *Water Streett* | Medium | High | High |
| 9) Encourage residents to elevate houses above base flood elevation | *Water Street* | High | Medium | Medium |
| 10) Protection and acquisition of open space parcels. | *Town-wide* | High | Medium | Medium |

**Table 33: Mitigation Measure Prioritization**

| Mitigation Measure | Geographic Coverage | Estimate Cost | Estimated Benefit | 2018 Priority |
|---|---|---|---|---|
| | | | | |
| 11) Increase administrative support to implement the Wetland Bylaw and regulations | *Town-wide* | Medium | Medium | Medium |
| 12) Establish a process to ensure that elevation certificates are provided by building permit applicants for work in high hazard flood areas. | *Town-wide* | Low | Medium | Medium |
| 13) Formally designate a Floodplain Manager for the Town | *Town-wide* | Low | Medium | Medium |
| 14) The Town should apply to participate in FEMA's Community Rating System | *Town-wide* | Low | Low | Low |
| **Coastal Hazards** | | | | |
| 15) Elevate the two low-lying sections of the road that flood during coastal storm surge events and isolates 1200 (winter) residents in about 600 homes (current design) | *Jeffrey's Neck Road* | High | High | High |
| 16) Replace existing stone, 4 x 4 culvert with larger pre-cast concrete culvert. | *Labor in Vain Road* | High | High | High |
| 17) Flood-proof pump station; elevate critical facilities; explore alternative pump station locations | *Town Wharf Pump Station* | High | High | High |
| 18) Elevate Boardwalk | *Crane Beach* | High | High | High |
| 19) Elevate Argilla Road | *Crane Beach* | High | High | Medium |
| 20) Dune protection and nourishment | *Pavilion Beach* | TBD | Medium | Medium |

**Table 33: Mitigation Measure Prioritization**

| Mitigation Measure | Geographic Coverage | Estimate Cost | Estimated Benefit | 2018 Priority |
|---|---|---|---|---|
| **Dams** | | | | |
| 21) Complete feasibility study and analyze options for removal. Test borings have been done by EBSCO | *Ipswich Mills Dam* | Low | Low | Low |
| 22) Conduct Dam repairs | *Dow Brook Reservoir Dam* | High | High | High |
| **Wind Hazards** | | | | |
| 23) Improve access by developing unpaved road/trail to be accessed by 4x4 vehicle. | *Power Supply Right of Way: Dual, 23kV, supply line.* | High | High | High |
| **Wildfire Hazards** | | | | |
| 24) Acquire protective wildland firefighting gear. | *Town-wide* | Medium | Medium | Medium |
| 25) Evaluate the status of fire access roads and maintain or upgrade if needed | *Town-wide* | Low | Medium | Medium |
| **Geologic Hazards** | | | | |
| 26) Identify public buildings that may be vulnerable to damage from earthquakes and conduct a structural assessment if needed | *Municipal Buildings* | Medium | Low | Low |
| **Winter Hazards** | | | | |
| 27) Identify public buildings that may be vulnerable to damage from snow loads and conduct a structural assessment if needed | *Municipal buildings* | Medium | Low | Low |

**Table 33: Mitigation Measure Prioritization**

| Mitigation Measure | Geographic Coverage | Estimate Cost | Estimated Benefit | 2018 Priority |
|---|---|---|---|---|
| **Drought Hazards** | | | | |
| 28) Evaluate vulnerability of the Brown's Well to the combined impacts of riverine and coastal flooding and salt water infiltration due to sea level rise; consider developing an alternative well site. | *Town-wide* | High | High | High |
| **Extreme Temperatures** | | | | |
| 29) Conduct a public awareness program on the risks of extreme temperatures and resources available to residents | *Town-wide* | Low | Medium | Medium |
| **Multi-Hazards** | | | | |
| 30) Develop and implement a Town-wide generator plan:<br>• Purchase six mobile, 2500 Kw multi-fuel generators<br>• Purchase two mobile, 5500 Kw multi-fuel generators for use by Emergency Management<br>• Provide one fixed, 10,000 Kw for Department of Public Works facility and garage | *Town-wide* | High | High | High |
| 31) Update or replace existing Incident Command Center/Public Safety Bldg. | *Public Safety Building* | High | High | High |
| 32) Resilience of local community critical power supply<br><br>32A) Investigate improvements to fuel supply constraints.<br><br>32B) Upgrade one or more engines to improve frequency control, black start ability, and islanding operations. | *Town-wide* | High | High | High |

**Table 33: Mitigation Measure Prioritization**

| Mitigation Measure | Geographic Coverage | Estimate Cost | Estimated Benefit | 2018 Priority |
|---|---|---|---|---|
| 32C) Modernize electric switchgear to increase process automation and personnel safety.<br><br>32D) Explore opportunities to incorporate renewable energy and/or battery storage technology into plant operations; make facility ready. | | | | |
| 33) Site Security and monitoring at ELD's 272/276 High St Campus, Fowlers Lane Campus, and Vermette Court Substation<br><br>33A) Improve physical accessibility for routine patrol and enhanced visibility, with minimum standoff distance.<br><br>33B) Enhance monitoring with select video surveillance.<br><br>33C) Upgrade physical barriers, including gates, fences, doors and structures to limit unauthorized access. | *Electric Light Dept's 272/276 High St Campus, Fowlers Lane Campus, and Vermette Court Substation* | Medium | Medium | Medium |

**Recommended Mitigation Measures**

The recommended mitigation measures are summarized in Table 34. For each mitigation measure, the following is provided:

Description of the Mitigation Measure – The description of each mitigation measure is brief and cost information is given only if cost data were already available from the community. The cost data represent a point in time and would need to be adjusted for inflation and for any changes or refinements in the design of a particular mitigation measure.

Priority – As described above and summarized in Table 29, the designation of high, medium, or low priority was done considering potential benefits and estimated project costs, as well as other factors in the STAPLEE analysis.

Implementation Responsibility – The designation of implementation responsibility was done based on a general knowledge of what each municipal department is responsible for. It is likely that most mitigation measures will require that several departments work together and assigning staff is the sole responsibility of the governing body of each community.

Time Frame – The time frame was based on a combination of the priority for that measure, the complexity of the measure and whether or not the measure is conceptual, in design, or already designed and awaiting funding. Because the time frame for this plan is five years, the timing for all mitigation measures has been kept within this framework. The identification of a likely time frame is not meant to constrain a community from taking advantage of funding opportunities as they arise.

Potential Funding Sources – This column attempts to identify the most likely sources of funding for a specific measure. The information on potential funding sources in this table is preliminary and varies depending on a number of factors. These factors include whether or not a mitigation measure has been studied, evaluated or designed, or if it is still in the conceptual stages. MEMA and DCR assisted MAPC in reviewing the potential eligibility for hazard mitigation funding. Each grant program and agency has specific eligibility requirements that would need to be taken into consideration. In most instances, the measure will require a number of different funding sources. Identification of a potential funding source in this table does not guarantee that a project will be eligible for, or selected for funding. Upon adoption of this plan, the local team responsible for its implementation should begin to explore the funding sources in more detail.

Additional information on funding sources – The best way to determine eligibility for a particular funding source is to review the project with a staff person at the funding agency. The following websites provide an overview of programs and funding sources.

> Army Corps of Engineers (ACOE) – The website for the North Atlantic district office is http://www.nae.usace.army.mil/. The ACOE provides assistance in a number of types of projects including shoreline/stream bank protection, flood damage reduction, flood plain management services and planning services.
>
> Massachusetts Emergency Management Agency (MEMA) – The grants page http://www.mass.gov/dem/programs/mitigate/grants.htm has a useful table that compares eligible projects for the Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program.

**Abbreviations Used in Table 34**

ACOE = Army Corps of Engineers.
CIP= Capital Improvement Program
CIP= Capital Improvement Plan
CZM = Coastal Zone Management
DCR = MA Department of Conservation and Recreation
DHS/EOPS = Department of Homeland Security/Emergency Operations
DEP (SRF) = Department of Environmental Protection (State Revolving Fund)
DMF = Division of Marine Fisheries
FEMA Mitigation Grants includes:
- FMA = Flood Mitigation Assistance Program.
- HMGP = Hazard Mitigation Grant Program.
- PDM = Pre-Disaster Mitigation Program

MA DOT = Massachusetts Department of Transportation
USDA = United States Department of Agriculture

**Table 34: Recommended Mitigation Measures**

| Hazard Category | Mitigation Measure | Priority | Implementation Responsibility | Time Frame | Estimated Cost | Potential Funding Sources |
|---|---|---|---|---|---|---|
| **Flooding** | | | | | | |
| *Flooding at 110 -112 County Road/Route 1A, 12-14 Heartbreak Road and southern end of Heartbreak Rd* | 1) Drainage study of affected areas (3 culverts have been replaced to date) | High | Ipswich Dept. of Public Works and MassDOT | 2023 | $150,000 | Town of Ipswich General Fund; MassDOT; FEMA |
| *Pine Swamp Road and culverts* | 2) Replace existing 18-inch corrugated culverts with 30-40-inch precast concrete culverts and elevate low section in road. | High | Ipswich Dept. of Public Works | 2023 | $50,000 culverts $40,000 road | Town of Ipswich General Fund; FEMA |
| *Linebrook Road culverts at Bull Brook* | 3) Upgrade Linebrook Road culverts – replacre at Bull Brook | High | Ipswich Dept. of Public Works | 2019-2022 | $500,000 | Town of Ipswich General Fund; FEMA |
| *Sewer trunk line along the Ipswich River, and siphon under the River* | 4) Replace/rehabilitate piping; protect by armoring line | High | Wastewater Department | 2019 | $1,000,000 | Ipswich Wastewater Enterprise Fund |
| *Topsfield Road culvert at Gravelly Brook* | 5) Replace culvert with structure based on design that is more resilient to erosion and meets the Mass. Stream Crossing standards | High | Ipswich Dept. of Public Works | 2019-2021 | $29,000 for 75% design; $400,000 for construction | Town of Ipswich General Fund; Grant from DMF for 75% Design |

| Hazard Category | Mitigation Measure | Priority | Implementation Responsibility | Time Frame | Estimated Cost | Potential Funding Sources |
|---|---|---|---|---|---|---|
| *Town Farm Road* | 6) Elevate 75 – 100-foot section of low section of Town Farm Road and increase culvert size i | Medium | Ipswich Dept. of Public Works | 2019-2022 | $700,000 | Town of Ipswich General Fund; FEMA |
| *Water Street* | 7) Stormwater improvements and coastal bank stabilization needed at the end of Summer St. | Medium | Ipswich Dept. of Public Works | 2019-2020 | $75–100,000 | Town of Ipswich General Fund; |
| | 8) Undercutting of coastal bank below Water Street must be addressed as the road and electric utilities are threatened. | Medium | Ipswich Dept. of Public Works | 2019-2023 | $100,000 permitting | Town of Ipswich General Fund; FEMA; CZM |
| | 9) Encourage residents to elevate houses above base flood elevation | Medium | Ipswich Dept. of Public Works | 2019-2023 | TBD | FEMA |
| *Land Protection* | 10) Protection and acquisition of open space parcels. | Medium | Open Space Committee and Conservation Commission | 2018-2023 | Approx. $4,000,000 | Town of Ipswich General Fund; Town Bond? |
| *Land Protection* | 11) Increase administrative support to implement the Wetland Bylaw and regulations | Medium | Conservation Commission | 2018-2023 | Additional staff, approx. $50,000 | Town of Ipswich General Fund; |

| Hazard Category | Mitigation Measure | Priority | Implementation Responsibility | Time Frame | Estimated Cost | Potential Funding Sources |
|---|---|---|---|---|---|---|
| *Town-wide flood management* | 12) Establish a process to ensure that elevation certificates are provided by building permit applicants for work in high hazard flood areas. | Medium | Building Inspector | 2019 | Staff time | Town of Ipswich General Fund; |
| *Town-wide flood management* | 13) Formally designate a Floodplain Manager for the Town | Medium | Town Manager | 2018 | Staff time | Town of Ipswich General Fund; |
| *Town-wide flood management* | 14) The Town should apply to participate in FEMA's Community Rating System | Low | Department of Planning and Development | 2018-2021 | Staff time | Town of Ipswich General Fund; |
| **Coastal Hazards** | | | | | | |
| *Jeffrey's Neck Road* | 15) Elevate the two low-lying sections of the road that flood during coastal storm surge events and isolates 1200 (winter) residents in about 600 homes (current design) | High | Ipswich Dept. of Public Works and Conservation Commission | 2022-23 | $2 million | Town of Ipswich General Fund; FEMA |
| *Labor in Vain Road* | 16) Replace existing stone, 4 x 4 culvert with larger pre-cast concrete culvert. | High | Ipswich Dept. of Public Works and Conservation Commission | 2023 | $400,000 - $500,000 | Town of Ipswich General Fund; FEMA |

| Hazard Category | Mitigation Measure | Priority | Implementation Responsibility | Time Frame | Estimated Cost | Potential Funding Sources |
|---|---|---|---|---|---|---|
| *Town Wharf Pump Station* | 17) Flood-proof pump station; elevate critical facilities; explore alternative pump station locations | High | Ipswich Wastewater Department | 2020-2023 | $5,000,000 | Ipswich Wastewater Enterprise Fund; FEMA; CZM |
| *Crane Beach* | 18) Elevate Boardwalk | High | Ipswich Dept. of Public Works | 2019-2023 | $350,000 | Seeking grant |
| *Crane Beach* | 19) Elevate Argilla Road | Medium | Ipswich Dept. of Public Works | 2018-2023 | $2,000,000 | CZM Grant - $200,000 for design |
| *Pavilion Beach* | 20) Dune protection and nourishment | Medium | Ipswich Dept. of Public Works | 2023 | TBD | Seeking grant |
| **Dams** | | | | | | |
| *Ipswich Mills Dam* | 21) Complete feasibility study and analyze options for removal. Test borings have been done by EBSCO | Low | Planning & Development Department and Ipswich Dept. of Public Works | 2018-2023 | Staff time | Town of Ipswich General Fund; DMF' NOAA |
| *Dow Brook Reservoir Dam* | 22) Conduct Dam repairs | High | Ipswich Water Department | 2018-2019 | $1,000,000 | Ipswich Water Enterprise Fund; EOEEA |

| Hazard Category | Mitigation Measure | Priority | Implementation Responsibility | Time Frame | Estimated Cost | Potential Funding Sources |
|---|---|---|---|---|---|---|
| **Wind Hazards** | | | | | | |
| *Power Supply Right of Way: Dual, 23kV, sub-transmission supply lines run parallel to deliver sole power supply to the Town.* | 23) Improve access by developing unpaved road/trail to be accessed by 4x4 vehicle. | High | Ipswich Electric Light Department | 2019-2020 | $150,000 | Ipswich ELD, FEMA, National Grid |
| **Wildfire Hazards** | | | | | | |
| *Brush Fires- Town-wide* | 24) Acquire protective wildland firefighting gear. | Medium | Fire Dept. | 2018-2020 | $40,000 | Town of Ipswich General Fund; FEMA |
| *Brush Fire-Town-wide* | 25) Evaluate the status of fire access roads and maintain or upgrade if needed | Medium | Fire Department | 2019-2022 | Staff time | Town of Ipswich General Fund; |
| **Geologic Hazards** | | | | | | |
| *Earthquakes* | 26) Identify public buildings that may be vulnerable to damage from earthquakes and conduct a structural assessment if needed | Low | Facilities Department | 2020-2022 | Staff time and $25K to $50K for assessment | Town of Ipswich General Fund |

| Hazard Category | Mitigation Measure | Priority | Implementation Responsibility | Time Frame | Estimated Cost | Potential Funding Sources |
|---|---|---|---|---|---|---|
| **Winter Hazards** | | | | | | |
| *Snow loads on public buildings* | 27) Identify public buildings that may be vulnerable to damage from snow loads and conduct a structural assessment if needed | Low | Facilities Department | 2020-2022 | Staff time and $25K to $50K for assessment | Town of Ipswich General Fund; |
| **Drought Hazards** | | | | | | |
| *Water Supply drought resilience* | 28) Evaluate vulnerability of the Brown's Well to the combined impacts of riverine and coastal flooding and salt water infiltration due to sea level rise; consider developing an alternative well site. | High | Ipswich Water Department | 2018-2021 | $3M to $10M | Ipswich Wastewater Enterprise Fund; State Revolving Fund (SRF) |
| **Extreme Temperatures** | | | | | | |
| *Extreme heat and cold* | 29) Conduct a public awareness program on the risks of extreme temperatures and resources available to residents | Medium | Board of Health | 2019-2020 | Staff time; cost for developing and printing materials | Town of Ipswich General Fund; |

| Hazard Category | Mitigation Measure | Priority | Implementation Responsibility | Time Frame | Estimated Cost | Potential Funding Sources |
|---|---|---|---|---|---|---|
| **Multi-Hazards** | | | | | | |
| *Multi-hazard power outage and communications* | 30) Develop and implement a Town-wide generator plan:<br>• Purchase six mobile, 2500 Kw multi-fuel generators<br>• Purchase two mobile, 5500 Kw multi-fuel generators for use by Emergency Management<br>• Provide one fixed, 10,000 Kw for Department of Public Works facility and garage | High | Police Department | 2019 | $400,000 | Town of Ipswich General Fund; FEMA |
| *Multi-hazard: power outage and communications* | 31) Update or replace existing Incident Command Center/Public Safety Bldg. | High | Police Department Fire Department | 2018-2022 | $20,000,000 | Town of Ipswich General Fund; |
| *Resilience of local community critical power supply* | 32A) Investigate improvements to fuel supply constraints.<br><br>32B) Upgrade one or more engines to improve frequency control, black start ability, and islanding operations. | High | Ipswich Electric Light Dept. | 2018-2023 | $10,000,000 | Ipswich ELD, FEMA, MA DOER MA Municipal Wholesale Electricity Cooperative Renewable Energy Trust and Clean Energy Center |

| Hazard Category | Mitigation Measure | Priority | Implementation Responsibility | Time Frame | Estimated Cost | Potential Funding Sources |
|---|---|---|---|---|---|---|
| | 32C) Modernize electric switchgear to increase process automation and personnel safety.<br><br>32D) Explore opportunities to incorporate renewable energy and/or battery storage technology into plant operations; make facility ready. | | | | | Microgrid program; Green Community? |
| *Site Security and monitoring at ELD's 272/276 High St Campus, Fowlers Lane Campus, and Vermette Court Substation* | 33A) Improve physical accessibility for routine patrol and enhanced visibility, with minimum standoff distance.<br><br>33B) Enhance monitoring with select video surveillance.<br><br>33C) Upgrade physical barriers, including gates, fences, doors and structures to limit unauthorized access. | Medium | Ipswich Utilities | 2018-2019 | $100,000 | Ipswich ELD, Dept. of Homeland Security, MIIA |

# IX. PLAN ADOPTION AND MAINTENANCE

## Plan Adoption

The Ipswich Hazard Mitigation Plan 2018 Update was adopted by the Board of Selectmen on [ADD DATE]. See Appendix D for documentation. The plan was approved by FEMA on [ADD DATE] for a five-year period that will expire on [ADD DATE]. – *To be completed following MEMA and FEMA review*.

## Plan Maintenance

Although several of the mitigation measures from the Town's previous Hazard Mitigation Plan have been implemented, since that plan was adopted there has not been an ongoing local process to guide implementation of the plan. Such a process is needed over the next five years for the implementation of this plan update, and will be structured as described below.

MAPC worked with the Ipswich Hazard Mitigation Planning Team to prepare this plan. After approval of the plan by FEMA, this group will meet on a regular basis, at least annually, to function as the Hazard Mitigation Implementation Team, with the Director of Public Works designated as the coordinator. Additional members could be added to the local implementation team from businesses, non-profits and institutions. The Town will encourage public participation during the next 5-year planning cycle. As updates and a review of the plan are conducted by the Hazard Mitigation Implementation Team, these will be placed on the Town's web site, and any meetings of the Hazard Mitigation Implementation Team will be publicly noticed in accordance with Town and state open meeting laws.

## Implementation and Evaluation Schedule

Mid-Term Survey on Progress– The coordinator of the Hazard Mitigation Implementation Team will prepare and distribute a survey in year three of the plan. The survey will be distributed to all of the local implementation group members and other interested local stakeholders. The survey will poll the members on any changes or revisions to the plan that may be needed, progress and accomplishments for implementation, and any new hazards or problem areas that have been identified.

This information will be used to prepare a report or addendum to the local hazard mitigation plan in order to evaluate its effectiveness in meeting the plan's goals and identify areas that need to be updated in the next plan. The Hazard Mitigation Implementation Team, coordinated by the Director of Public Works, will have primary responsibility for tracking progress and updating the plan.

Begin to prepare for the next Plan Update -- Given the lead time needed to secure funding and conduct the planning process, the Hazard Mitigation Implementation Team will

begin to prepare for an update of the plan in year three. The team will use the information from the Mid-Term progress review to identify the needs and priorities for the plan update and seek funding for the plan update process. Potential sources of funding may include FEMA Pre-Disaster Mitigation grants and the Hazard Mitigation Grant Program. Both grant programs can pay for 75% of a planning project, with a 25% local cost share required.

Prepare and Adopt an Updated Local Hazard Mitigation Plan – FEMA's approval of this plan is valid for five years, by which time an updated plan must be approved by FEMA in order to maintain the Town's approved plan status and its eligibility for FEMA mitigation grants. Once the resources have been secured to update the plan, the Hazard Mitigation Implementation Team may decide to undertake the update themselves, contract with the Metropolitan Area Planning Council to update the plan or to hire another consultant. However the Hazard Mitigation Implementation Team decides to update the plan, the group will need to review the current FEMA hazard mitigation plan guidelines for any changes. The Ipswich Hazard Mitigation Plan Update will be forwarded to MEMA and DCR for review and to FEMA for approval.

**Integration of the Plans with Other Planning Initiatives**

Upon approval of the Ipswich Hazard Mitigation Plan 2017 Update by FEMA, the Local Hazard Mitigation Team coordinator will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work. The plan will be reviewed and discussed with the following departments during the first six (6) months following plan adoption. During updates of any town department's plans or policies, the relevant portions of this mitigation strategy will be incorporated.

- Fire Department
- Emergency Management
- Police Department
- Public Works Department
- Planning Board
- Conservation Commission
- Board of Health
- Building

Other groups that will be coordinated with include large institutions, Chambers of Commerce, land conservation organizations and watershed groups. The plans will also be posted on a community's website with the caveat that local team coordinator will review the plan for sensitive information that would be inappropriate for public posting. The posting of the plan on a web site will include a mechanism for citizen feedback such as an e-mail address to send comments.

The Hazard Mitigation Plan will be integrated into other Town plans and policies as they are updated and renewed, including the Ipswich Master Plan, Open Space Plan, Comprehensive Emergency Management Plan, and Capital Investment Program.

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# X. LIST OF REFERENCES

Environment America Research and Policy Center, *When It Rains It Pours – Global Warming and the Increase in Extreme Precipitation*, July 2012

FEMA Flood Insurance Study, Town of Ipswich, MA Federal Emergency Management Agency, Revised August 19, 1991

FEMA, Local Mitigation Plan Review Guide; October 1, 2011.

Federal Emergency Management Agency, Flood Insurance Rate Maps for Essex County, MA, 2012 and 2014

Ipswich River Watershed Association (IRWA): Miles River Restoration Opportunities

MA Emergency Management Agency, State *Hazard Mitigation Plan*, 2013

MA Geographic Information System, *McConnell Land Use Statistics*, 2005

MA Office of Dam Safety, Inventory of Massachusetts Dams

Metropolitan Area Planning Council, Geographic Information Systems Lab

Metropolitan Area Planning Council, Regional Plans and Data

New England Seismic Network, Weston Observatory, http://aki.bc.edu/index.htm

Northeast States Emergency Consortium, website http://www.nesec.org/

NOAA, National Centers for Environmental Information

Town of Ipswich Subdivision Rules and Regulations

Town of Ipswich Open Space and Recreation Plan,2013

Town of Ipswich Stormwater Bylaw

Town of Ipswich Zoning Bylaws

U. S. Census, 2010, and American Community Survey, 2016

USGS, National Water Information Center, https://waterdata.usgs.gov/nwis

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# APPENDIX A

# HAZARD MITIGATION PLANNING TEAM MEETING AGENDAS

# AGENDA

## Ipswich Hazard Mitigation Plan Update

Local Hazard Mitigation Planning Team

Meeting #1
November 27, 2017
10:00AM
Ipswich Town Hall

---

### 1. Review Project Scope of Work and Schedule

### 2. Update Critical Facilities Inventory and Mapping

### 3. Identify/update local hazards:

a) Flood Hazard Areas
b) Fire Hazard Areas (brushfires/wildfires)
c) Dams
d) Other hazards

### 4. Identify/Update New and Potential Development Sites

### 5. Discuss Public Involvement and Outreach

a) Identify local stakeholders
b) Schedule first public meeting

# AGENDA

## Ipswich Hazard Mitigation Plan Update

Local Hazard Mitigation Planning Team

### Meeting #2

March 29, 2018
10:00AM
Ipswich Town Hall

---

### 1. Review Status of Existing Hazard Mitigation Measures

- Review and update the existing Mitigation Measures included in the 2012 Hazard Mitigation Plan

### 2. Review and Update Hazard Mitigation Goals

Review the Hazard Mitigation Goals included in the 2012 plan sand decide on any updates or additions, including climate change

### 3. Review the Recommended Mitigation Strategy from the 2012 Hazard Mitigation Plan

- Review and update the Recommended Mitigation Strategy included in the 2012 Hazard Mitigation Plan; designate those mitigation measures completed and those to be carried over to the new plan

# AGENDA

## Ipswich Hazard Mitigation Plan Update

Local Hazard Mitigation Planning Team

### Meeting #3

July 18, 2018
10:00AM
Ipswich Town Hall

---

## 1. Update the Hazard Mitigation Strategy

e) Update Mitigation Measures recommended in the previous plan
f) Add new Mitigation Measures for the 2018 plan
g) Identify time frames, cost estimates, lead agencies

## 2. Review and Update Hazard Mitigation Goals

## 3. Public Involvement and Outreach

c) Identify local stakeholders
d) Schedule second public meeting

# APPENDIX B
# HAZARD MAPPING

The MAPC GIS (Geographic Information Systems) Lab produced a series of maps for each community. Some of the data came from the Northeast States Emergency Consortium (NESEC). More information on NESEC can be found at http://www.serve.com/NESEC/. Due to the various sources for the data and varying levels of accuracy, the identification of an area as being in one of the hazard categories must be considered as a general classification that should always be supplemented with more local knowledge.

The map series consists of eight maps as described below. The maps in this appendix are necessarily reduced scale versions for general reference.

| | |
|---|---|
| Map 1. | Population Density |
| Map 2. | Potential Development |
| Map 3. | Flood Zones |
| Map 4. | Earthquakes and Landslides |
| Map 5. | Hurricanes and Tornadoes |
| Map 6. | Average Snowfall |
| Map 7. | Composite Natural Hazards |
| Map 8. | Hazard Areas |

***Map1: Population Density*** – This map uses the US Census block data for 2010 and shows population density as the number of people per acre in seven categories with 60 or more people per acre representing the highest density areas.

***Map 2: Development*** – This map shows potential future developments, and critical infrastructure sites. MAPC consulted with Town staff to determine areas that were likely to be developed or redeveloped in the future. The map also depicts current land use.

***Map 3: Flood Zones*** – The map of flood zones used the FEMA NFIP Flood Zones as depicted on the FIRMs (Federal Insurance Rate Maps) for Essex County as its source. This map is not intended for use in determining whether or not a specific property is located within a FEMA NFIP flood zone. The currently adopted FIRMS for Ipswich are kept by the Town. For more information, refer to the FEMA Map Service Center website b. The definitions of the flood zones are described in detail on this site as well. The flood zone map for each community also shows critical infrastructure and repetitive loss areas.

***Map 4: Earthquakes and Landslides*** **–** This information came from NESEC. For most communities, there was no data for earthquakes because only the epicenters of an earthquake are mapped.

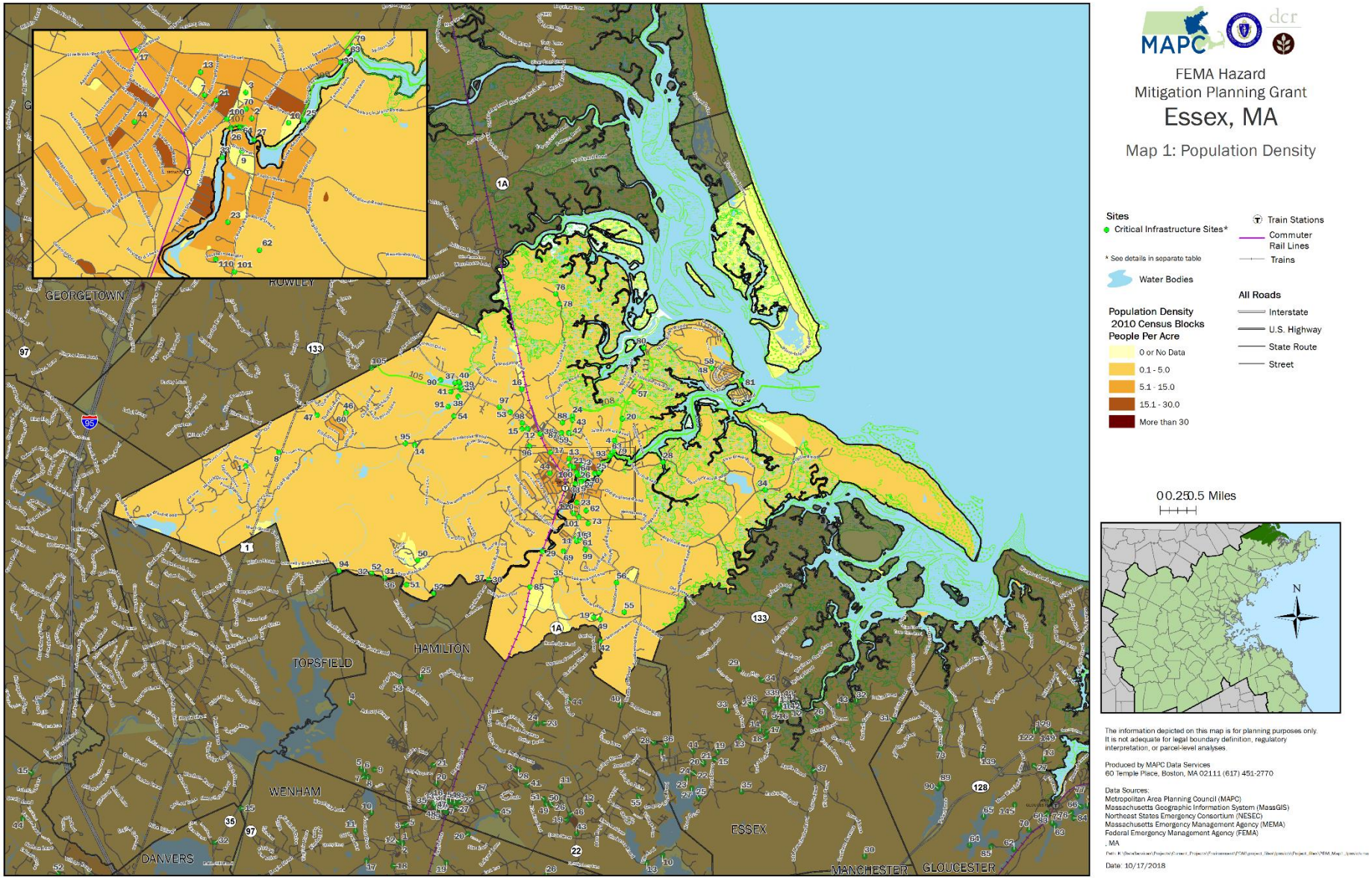
The landslide information shows areas with either a low susceptibility or a moderate susceptibility to landslides based on mapping of geological formations. This mapping is highly general in nature. For more information on how landslide susceptibility was mapped, refer to http://pubs.usgs.gov/pp/p1183/pp1183.html.

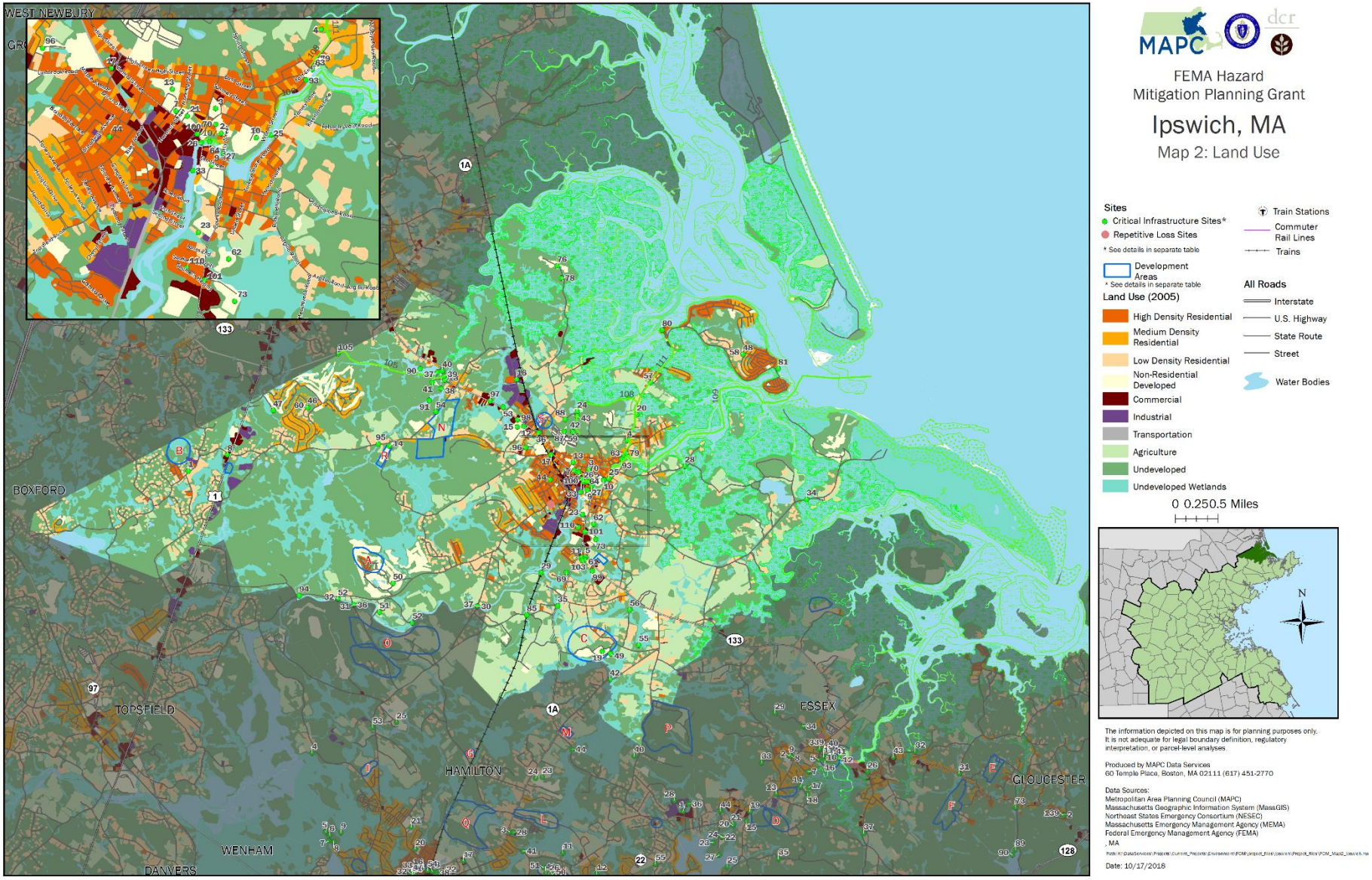
***Map 5: Hurricanes and Tornadoes*** **–** This map shows a number of different items. The map includes the storm tracks for both hurricanes and tropical storms, if any occurred in this community. This information must be viewed in context. A storm track only shows where the eye of the storm passed through. In most cases, the effects of the wind and rain from these storms were felt in other communities even if the track was not within that community. This map also shows the location of tornadoes with a classification as to the level of damages. What appears on the map varies by community since not all communities experience the same wind-related events. These maps also show the 100 year wind speed.

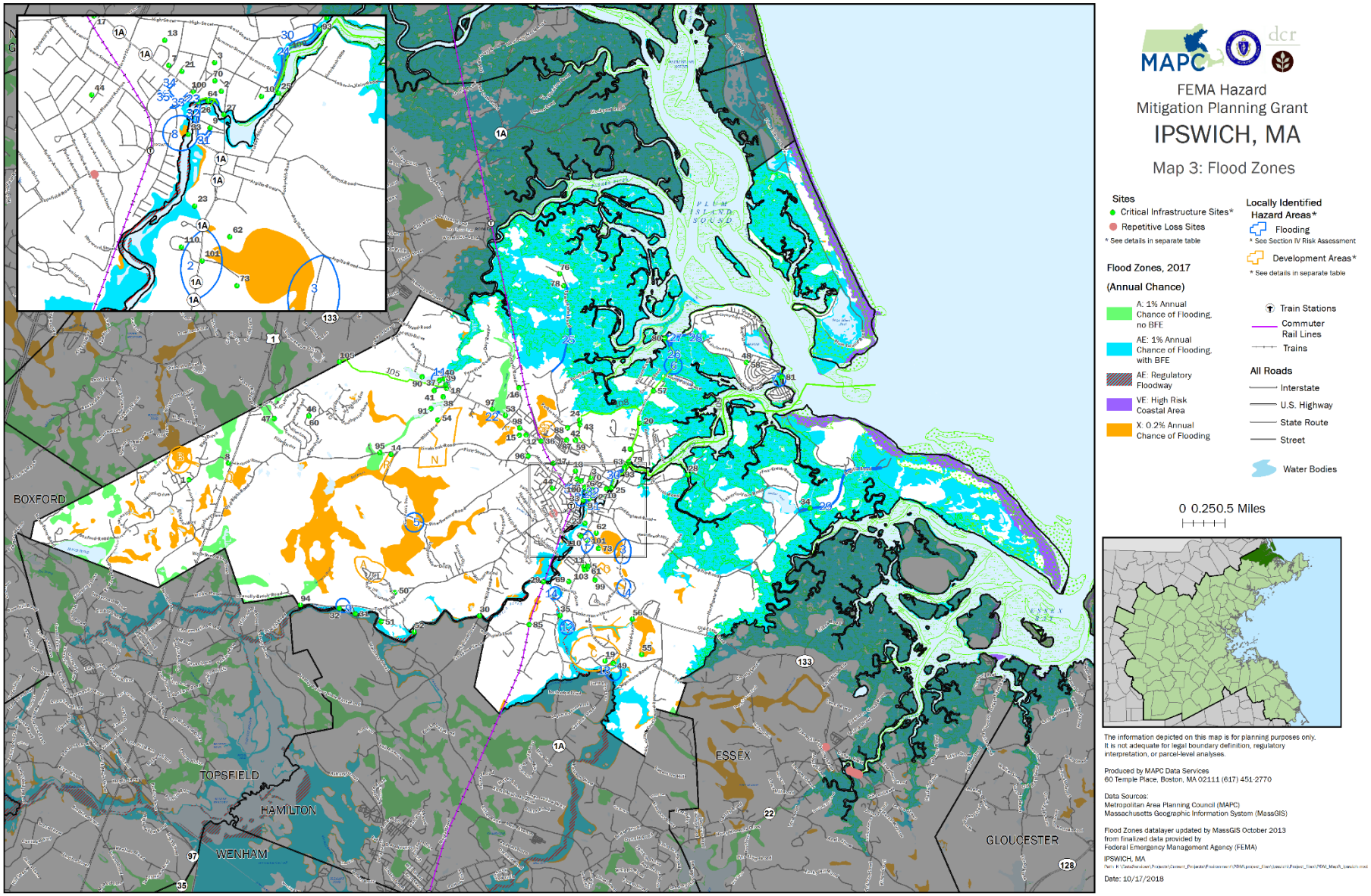
***Map 6: Average Snowfall*** **- -** This map shows the average snowfall. It also shows storm tracks for nor'easters, if any storms tracked through the community.

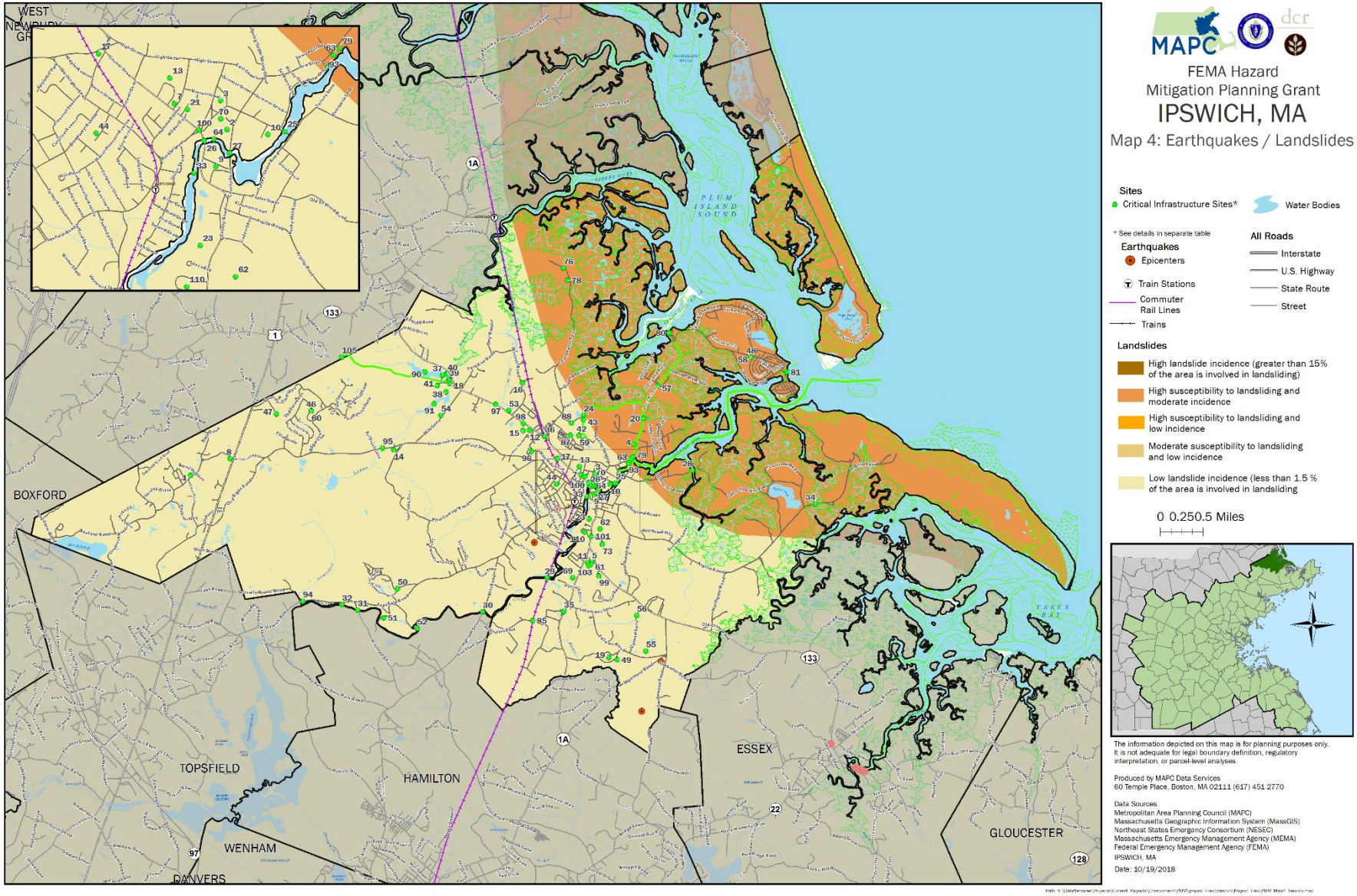
***Map 7: Composite Natural Hazards*** **-** This map shows four categories of composite natural hazards for areas of existing development. The hazards included in this map are 100 year wind speeds of 110 mph or higher, low and moderate landslide risk, FEMA Q3 flood zones (100 year and 500 year) and hurricane surge inundation areas. Areas with only one hazard were considered to be low hazard areas. Moderate areas have two of the hazards present. High hazard areas have three hazards present and severe hazard areas have four hazards present.

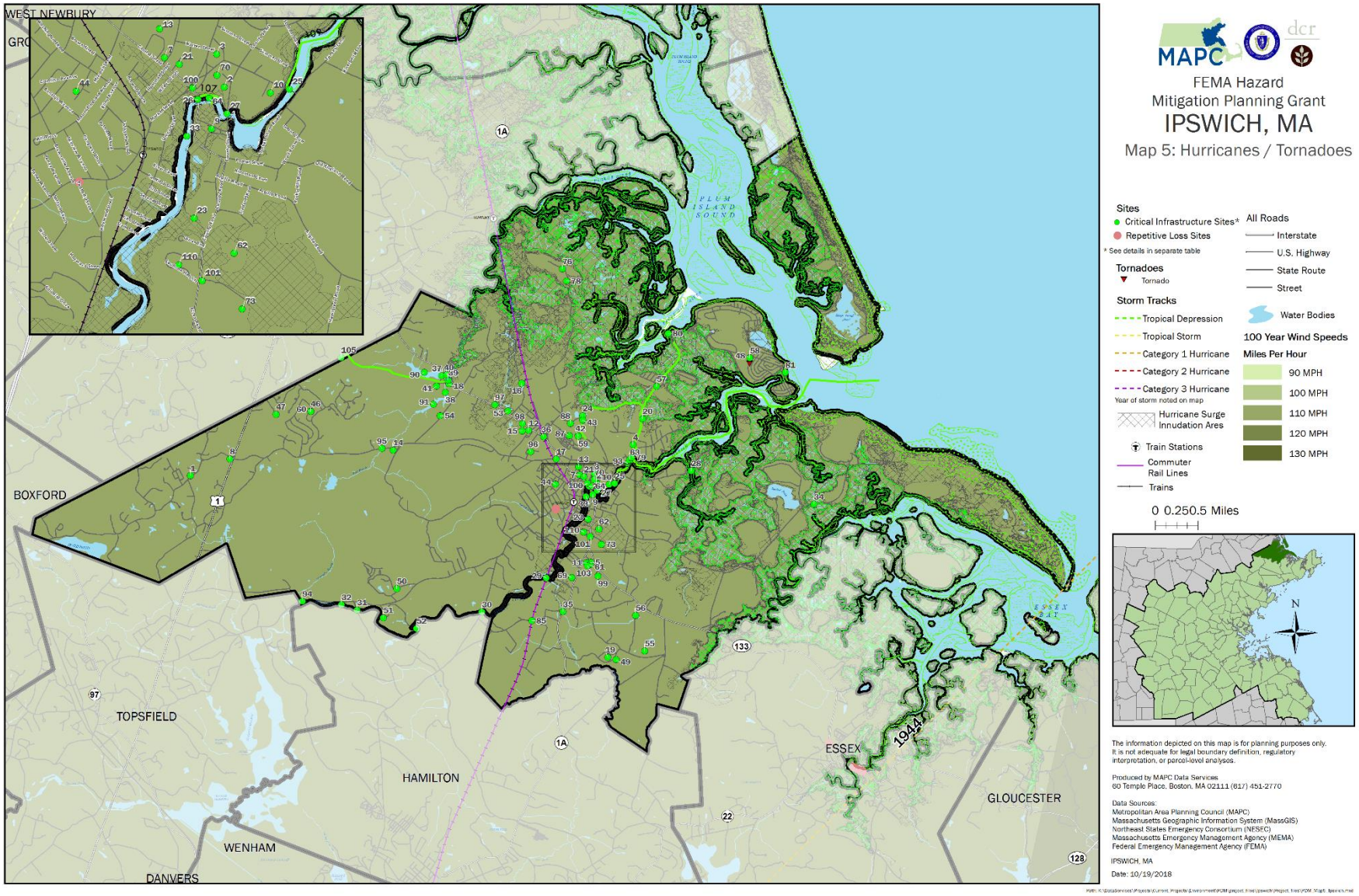
***Map 8: Hazard Areas*** **–** For each community, locally identified hazard areas are overlaid on an aerial photograph dated April, 2010. The critical infrastructure sites are also shown. The source of the aerial photograph is Mass GIS.

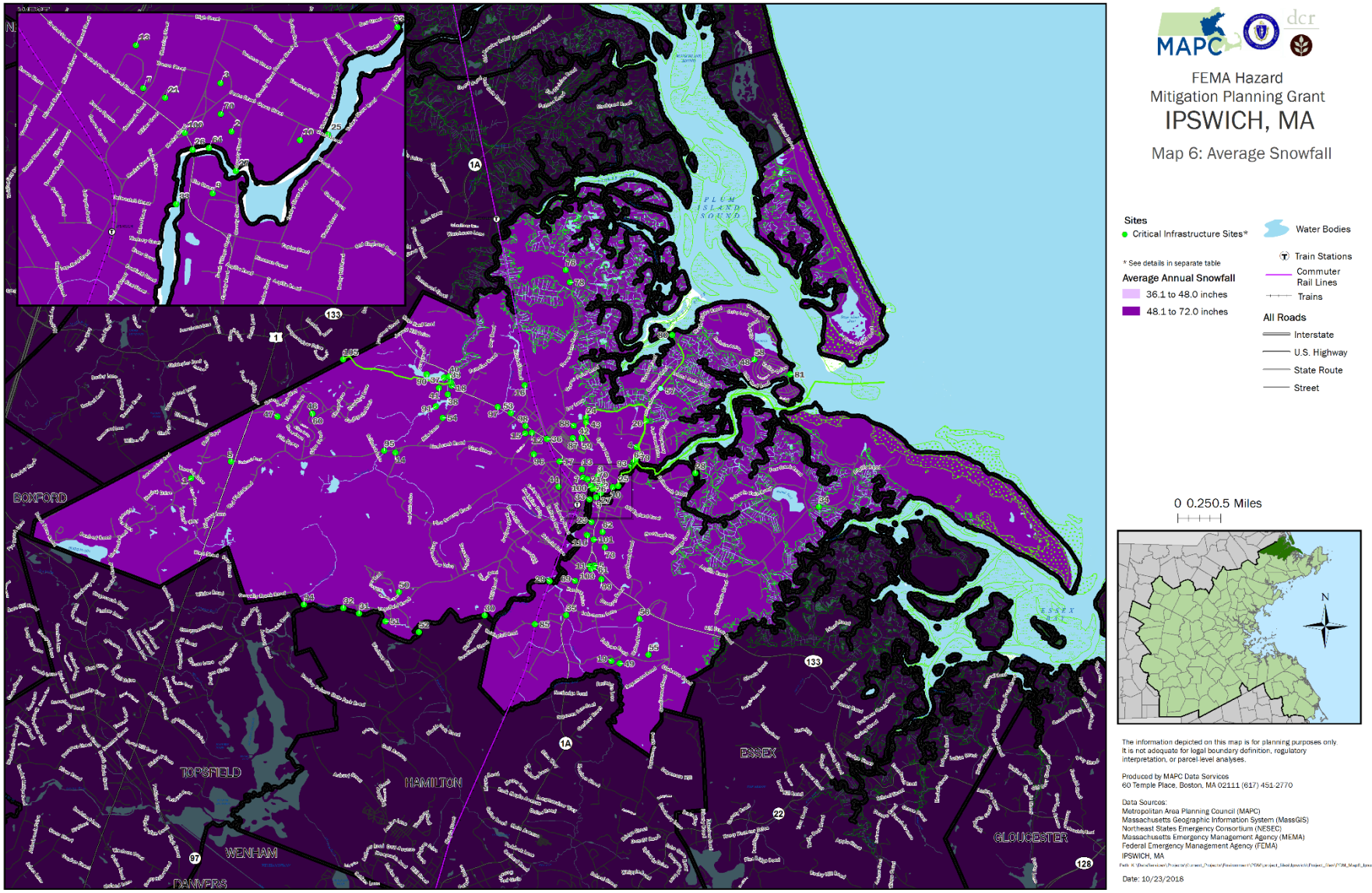

MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
Essex, MA
Map 1: Population Density
Sites
Critical Infrastructure Sites*
* See details in separate table
Water Bodies
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Population Density
2010 Census Blocks
People Per Acre
0 or No Data
0.1 - 5.0
5.1 - 15.0
15.1 - 30.0
More than 30
0 0.25 0.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
, MA
Date: 10/17/2018
GEORGETOWN
ROWLEY
HAMILTON
TOPSFIELD
WENHAM
DANVERS
ESSEX
MANCHESTER
GLOUCESTER


WEST NEWBURY
BOXFORD
TOPSFIELD
HAMILTON
WENHAM
DANVERS
ESSEX
GLOUCESTER
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
Ipswich, MA
Map 2: Land Use
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Development Areas
* See details in separate table
Land Use (2005)
High Density Residential
Medium Density Residential
Low Density Residential
Non-Residential Developed
Commercial
Industrial
Transportation
Agriculture
Undeveloped
Undeveloped Wetlands
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Water Bodies
0 0.250.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
, MA
Date: 10/17/2018


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
IPSWICH, MA
Map 3: Flood Zones
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Flood Zones, 2017
(Annual Chance)
A: 1% Annual Chance of Flooding, no BFE
AE: 1% Annual Chance of Flooding, with BFE
AE: Regulatory Floodway
VE: High Risk Coastal Area
X: 0.2% Annual Chance of Flooding
Locally Identified Hazard Areas*
Flooding
* See Section IV Risk Assessment
Development Areas*
* See details in separate table
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Water Bodies
0 0.250.5 Miles
BOXFORD
TOPSFIELD
HAMILTON
WENHAM
ESSEX
GLOUCESTER
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Flood Zones datalayer updated by MassGIS October 2013
from finalized data provided by
Federal Emergency Management Agency (FEMA)
IPSWICH, MA
Date: 10/17/2018


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
IPSWICH, MA
Map 4: Earthquakes / Landslides
Sites
Critical Infrastructure Sites*
Water Bodies
* See details in separate table
Earthquakes
Epicenters
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Landslides
High landslide incidence (greater than 15% of the area is involved in landsliding)
High susceptibility to landsliding and moderate incidence
High susceptibility to landsliding and low incidence
Moderate susceptibility to landsliding and low incidence
Low landslide incidence (less than 1.5 % of the area is involved in landsliding)
0 0.250.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
IPSWICH, MA
Date: 10/19/2018
BOXFORD
TOPSFIELD
HAMILTON
WENHAM
DANVERS
ESSEX
GLOUCESTER
PLUM ISLAND SOUND
ESSEX BAY


WEST NEWBURY
BOXFORD
TOPSFIELD
HAMILTON
WENHAM
DANVERS
ESSEX
GLOUCESTER
PLUM ISLAND SOUND
ESSEX BAY
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
IPSWICH, MA
Map 5: Hurricanes / Tornadoes
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Tornadoes
Tornado
Storm Tracks
Tropical Depression
Tropical Storm
Category 1 Hurricane
Category 2 Hurricane
Category 3 Hurricane
Year of storm noted on map
Hurricane Surge Innudation Ares
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
Water Bodies
100 Year Wind Speeds
Miles Per Hour
90 MPH
100 MPH
110 MPH
120 MPH
130 MPH
0 0.250.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
IPSWICH, MA
Date: 10/19/2018


MAPC
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FEMA Hazard
Mitigation Planning Grant
IPSWICH, MA
Map 6: Average Snowfall
Sites
Critical Infrastructure Sites*
* See details in separate table
Average Annual Snowfall
36.1 to 48.0 inches
48.1 to 72.0 inches
Water Bodies
Train Stations
Commuter Rail Lines
Trains
All Roads
Interstate
U.S. Highway
State Route
Street
0 0.250.5 Miles
N
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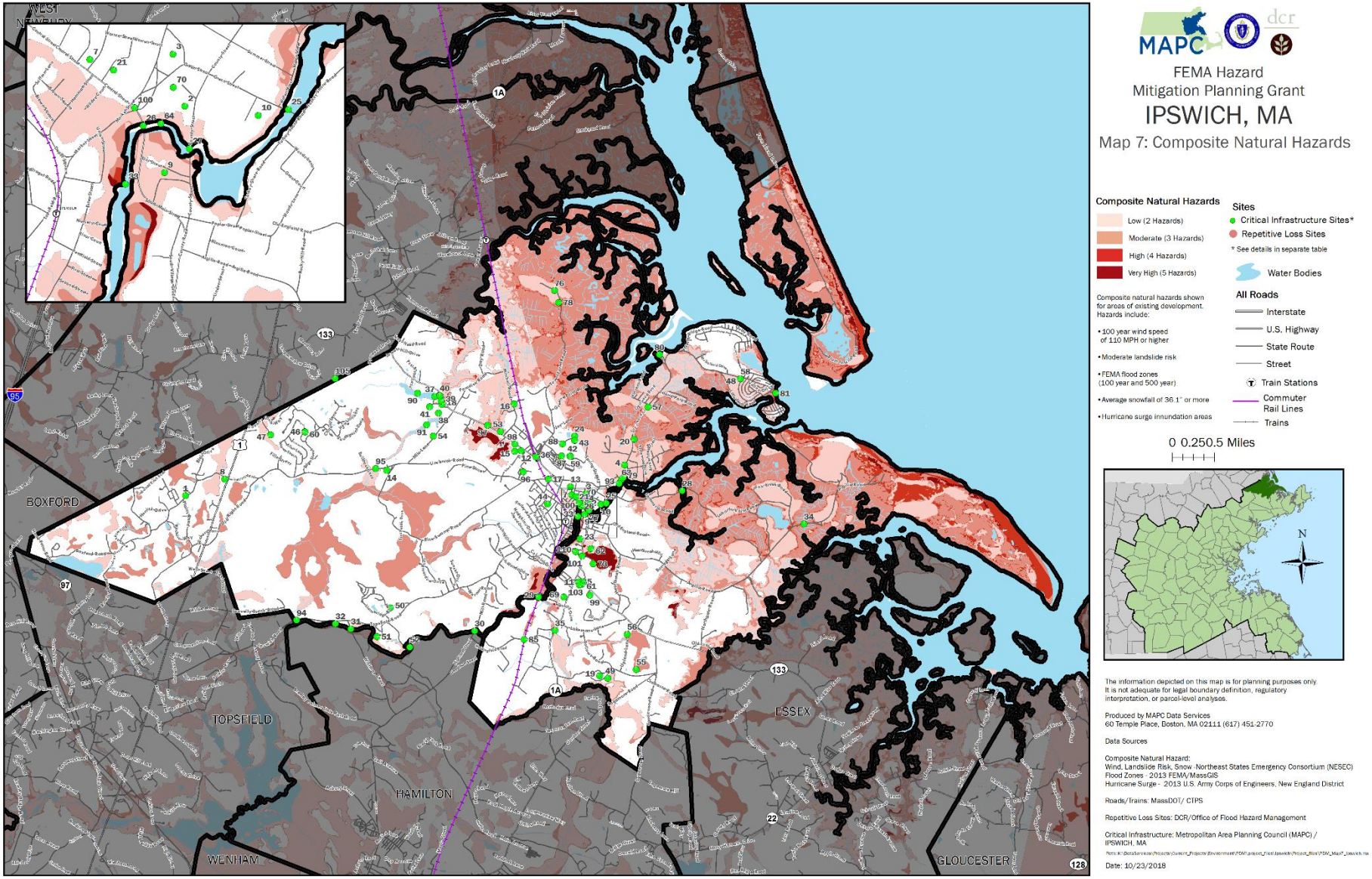
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
IPSWICH, MA
Date: 10/23/2018
BOXFORD
TOPSFIELD
HAMILTON
WENHAM
DANVERS
ESSEX
GLOUCESTER
PLUM ISLAND SOUND
1A
133
97
128
22


MAPC
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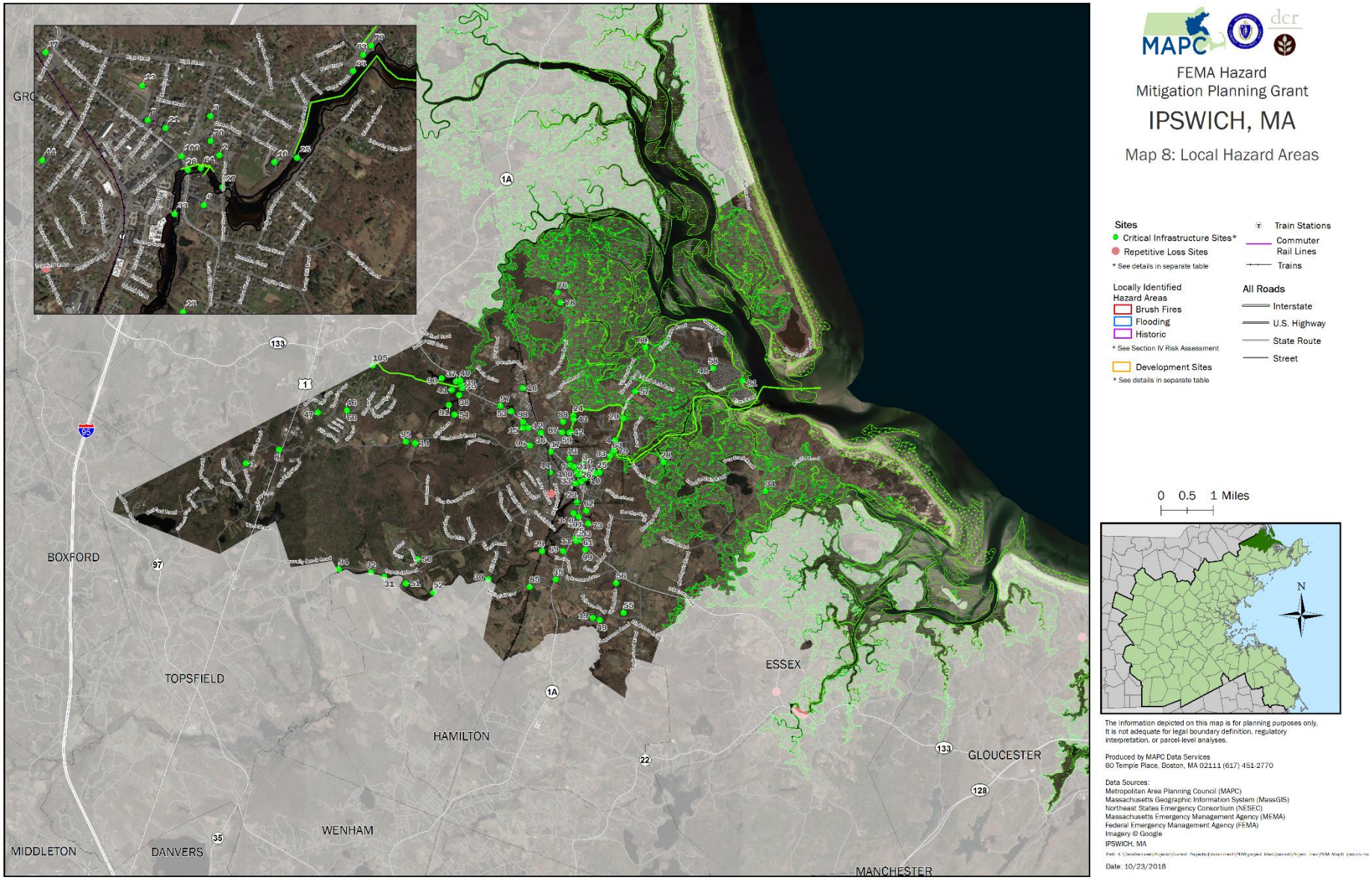
FEMA Hazard
Mitigation Planning Grant
IPSWICH, MA
Map 7: Composite Natural Hazards
Composite Natural Hazards
Low (2 Hazards)
Moderate (3 Hazards)
High (4 Hazards)
Very High (5 Hazards)
Composite natural hazards shown for areas of existing development. Hazards include:
• 100 year wind speed of 110 MPH or higher
• Moderate landslide risk
• FEMA flood zones (100 year and 500 year)
• Average snowfall of 36.1" or more
• Hurricane surge innundation areas
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Street
Train Stations
Commuter Rail Lines
Trains
0 0.250.5 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources
Composite Natural Hazard:
Wind, Landslide Risk, Snow -Northeast States Emergency Consortium (NESEC)
Flood Zones - 2013 FEMA/MassGIS
Hurricane Surge - 2013 U.S. Army Corps of Engineers, New England District
Roads/Trains: MassDOT/ CTPS
Repetitive Loss Sites: DCR/Office of Flood Hazard Management
Critical Infrastructure: Metropolitan Area Planning Council (MAPC) / IPSWICH, MA
Date: 10/23/2018
BOXFORD
TOPSFIELD
HAMILTON
WENHAM
ESSEX
GLOUCESTER
WEST NEWBURY


MAPC
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FEMA Hazard
Mitigation Planning Grant
IPSWICH, MA
Map 8: Local Hazard Areas
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Train Stations
Commuter Rail Lines
Trains
Locally Identified Hazard Areas
Brush Fires
Flooding
Historic
* See Section IV Risk Assessment
Development Sites
* See details in separate table
All Roads
Interstate
U.S. Highway
State Route
Street
0 0.5 1 Miles
N
BOXFORD
TOPSFIELD
HAMILTON
ESSEX
GLOUCESTER
WENHAM
MIDDLETON
DANVERS
MANCHESTER
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © Google
IPSWICH, MA
Date: 10/23/2018

# APPENDIX C
# DOCUMENTATION OF PUBLIC PARTICIPATION

# Hazard Mitigation Plan
# Public Meeting

*Natural hazards can have serious impacts on the Town of Ipswich and its residents and businesses…*



The Ipswich Hazard Mitigation Plan is being updated to help the town reduce its vulnerability to natural hazard events such as flooding, hurricanes, and winter storms. Please join the Town for a public presentation and discussion about the update to the *Ipswich Hazard Mitigation Plan* at the Planning Board meeting:

| | |
|---|---|
| **Date:** | Thursday, March 29, 2018 |
| **Time:** | 7:30 pm |
| **Location:** | Town Hall, Room A<br>25 Green Street, Ipswich MA |

For more information, please contact
Martin Pillsbury at mpillsbury@mapc.org

MAPC
METROPOLITAN AREA PLANNING COUNCIL

Amanda Linehan, Communications Manager, Metropolitan Area Planning Council
617-933-0705, alinehan@mapc.org

**CALENDAR LISTING / MEDIA ADVISORY**

## IPSWICH DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT MARCH 29 PUBLIC MEETING

*Meeting to discuss the 2018 update of the Ipswich Hazard Mitigation Plan*

Who: Ipswich residents, business owners, representatives of non-profit organizations and institutions, and others who are interested in preventing and reducing damage from natural hazards.

What: At the Ipswich Planning Board meeting on Monday, December 3 at 7:20 PM, a presentation will be made by the Metropolitan Area Planning Council (MAPC), which is assisting the Town on the 2018 update of its Hazard Mitigation Plan.

The Town of Ipswich adopted its first Hazard Mitigation Plan in 2012, which was approved by the Federal Emergency Management Agency (FEMA). This 2018 draft plan will update the original plan. The plan identifies natural hazards affecting Ipswich such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the Town can take to reduce its vulnerability to these hazards.

When: Monday, December 3 at 7:30 PM

Where: Ipswich Planning Board Meeting
Ipswich Town Hall, Room A (2nd floor)
25 Green Street, Ipswich MA

MAPC is the regional planning agency for 101 communities in the metropolitan Boston area, promoting smart growth and regional collaboration. More information about MAPC is available at www.mapc.org.

##

**AGENDA**
**Ipswich, MA Planning Board Meeting and Public Hearing**
**Town Hall, Room A, 25 Green Street**
**Thursday, March 29, 2018 at 7:30 p.m.**

1. 7:30 p.m. Citizen Queries
2. 7:32 p.m.* Request by Michael DeBoer for ANR Plan Endorsement for 48 Pine Swamp Road, Assessor's Map 41A, Lot 9
3. 7:35 p.m.* Request by New England Biolabs for minor modification to site plan review and special permit for ground mount solar installation
4. 7:40 p.m.* *New Public Hearing:* Request by Carolyn Adams for a special permit for the conversion of an accessory structure into a dwelling unit at 288 Linebrook Road (Assessor's ID 27D-001-0), which is located in the RRA District, pursuant to *Sections IX.P* and *XI.J* of the Zoning Bylaw
5. 8:00 p.m. *New Public Hearing:* Zoning amendment relative to Open Space Preservation Zoning requirements (common driveways and applicability relative to contiguous property meaning)
6. 8:15 p.m.* *New Public Hearing:* Request by Kibby Squires-Pilla for extension of temporary certificate of occupancy relative to dwelling unit at 10 North Main Street
7. 8:45 p.m.* *Continued Public Hearing:* Proposed zoning article for 2018 Annual Town Meeting: [(1) Amend Footnote 11 to Table in Section VI- add option for satisfying public benefit requirement for density bonus and increasing max. bonus for the Central (CB) and General (GB) Business zoning districts; (2) amend Section VI.G. to allow Planning Board by special permit to apply CB floor maximum to GB district as well, and increase maximum building height in the CB and GB Districts by no more than 15%; and (3) amend Section VII in subsection H to enable the Zoning Board of Appeals by special permit to apply the off-site parking provision to mixed residential uses in all districts, and in subsection I to allow Planning Board by special permit to grant on-site parking exemption for mixed uses in the CB and GB Districts]
8. 9:00 p.m.* Presentation of Ipswich Hazard Mitigation Planning process from Martin Pillsbury of MAPC
9. 9:20 p.m.* *Continued Public Hearing:* Request by Curran & Sons Construction, Inc. for site plan review for the construction of a commercial building and site work at 49 Turnpike Road (Assessor's Map 38A, Lot 3A), located in the Limited Industrial zoning district, pursuant to *Section X* of the Zoning Bylaw- *to be continued at applicant's request*
10. 9:20 p.m.* *Continued Public Hearing:* Request by the Town of Ipswich (Open Space Program & Cemetery/Parks) for site plan review approval for the expansion of a parking area and site work at 24 Candlewood Road (Assessor's Map 63, Lot 4), located in the Rural Residence A district, pursuant to *Section X* of the Zoning Bylaw. *To be continued at applicant's request*

** Times are anticipated; items may be considered prior to or following the time indicated.*

MAPC
METROPOLITAN AREA PLANNING COUNCIL

*Smart Growth & Regional Collaboration*

**What is the Hazard Mitigation Plan Update?**
Hazard Mitigation planning is a proactive effort to identify actions that can be taken to reduce the dangers to life and property from natural hazard events.

**Why is this plan important?**
The Federal Disaster Mitigation Act of 2000 requires that a city or town have an approved hazard mitigation plan in order to qualify for federal funding from the following grant programs:

- Pre-Disaster Mitigation Competitive (PDM-C)
- Hazard Mitigation Grant Program (HMGP)
- Flood Mitigation Assistance (FMA)

Additionally, the plan provides a municipality the opportunity to review potential vulnerabilities to natural hazards and develop measures that can reduce or mitigate these vulnerabilities and be included in the local planning process.

**What goes into a hazard mitigation plan?**
A hazard mitigation plan assesses the municipality's risks and vulnerabilities to natural hazard events such as flooding, hurricanes, winter storms, and earthquakes. MAPC uses statewide data and information directly from the community to make this assessment.

The plan includes a set of goals related to the overall goal of hazard mitigation planning, an assessment of existing mitigation measures, and a set of new mitigation measures that will serve to advance the plan goals. The plan update will also look at implementation progress that has been made on mitigation measures from the previous plan.

**What is the Local Hazard Mitigation Committee?**
The Local Hazard Mitigation Committee includes and coordinates with representatives from a number of different Town departments including Public Works, Engineering, Health, Community Development, Emergency Management and Fire. This committee provides the local on-the-ground knowledge necessary to write this plan including information on local hazard areas and current mitigation measures. This committee also identifies and prioritizes mitigation measures to be included in the plan.

**How can the public become involved in the Hazard Mitigation planning process?**
Public participation is very important to the hazard mitigation planning process. FEMA requires a minimum of two public meetings. When the first draft of the plan is developed, the Town will provide an online link where the plan can be viewed and comments may be provided by the public.

60 Temple Place, Boston, MA 02111 • 617 451 2770 • Fax 617 482 7185 • www.mapc.org

# Hazard Mitigation Plan
# Public Meeting

*Natural hazards can have serious impacts on the Town of Ipswich and its residents and businesses…*



The Ipswich Hazard Mitigation Plan is being updated to help the town reduce its vulnerability to natural hazard events such as flooding, hurricanes, and winter storms. Please join the Town for a public presentation and discussion about the draft *Ipswich Hazard Mitigation Plan Update* at the Select Board meeting:

| | |
|---|---|
| **Date:** | Monday, December 3, 2018 |
| **Time:** | 7:20 pm |
| **Location:** | Town Hall, Room A<br>25 Green Street, Ipswich MA |

For more information, please contact
Martin Pillsbury at mpillsbury@mapc.org

MAPC
METROPOLITAN AREA PLANNING COUNCIL

Amanda Linehan, Communications Manager, Metropolitan Area Planning Council
617-933-0705, alinehan@mapc.org

**CALENDAR LISTING / MEDIA ADVISORY**

## IPSWICH DRAFT HAZARD MITIGATION PLAN TO BE PRESENTED AT DECEMBER 3 PUBLIC MEETING

*Meeting to present the 2018 update of the Ipswich Hazard Mitigation Plan*

Who: Ipswich residents, business owners, representatives of non-profit organizations and institutions, and others who are interested in preventing and reducing damage from natural hazards.

What: At the Ipswich Select Board meeting on Monday, December 3 at 7:20 PM, a presentation will be made by the Metropolitan Area Planning Council (MAPC), which is assisting the Town on the 2018 update of its Hazard Mitigation Plan.

The Town of Ipswich adopted its first Hazard Mitigation Plan in 2012, which was approved by the Federal Emergency Management Agency (FEMA). This 2018 draft plan will update the original plan. The plan identifies natural hazards affecting Ipswich such as floods, hurricanes, winter storms, and earthquakes, as well as actions that the Town can take to reduce its vulnerability to these hazards.

When: Monday, December 3 at 7:20 PM

Where: Ipswich Select Board Meeting
Ipswich Town Hall, Room A (2nd floor)
25 Green Street, Ipswich MA

MAPC is the regional planning agency for 101 communities in the metropolitan Boston area, promoting smart growth and regional collaboration. More information about MAPC is available at www.mapc.org.

##

MAPC METROPOLITAN AREA PLANNING COUNCIL SMART GROWTH AND REGIONAL COLLABORATION

November 19, 2018

Pamela B. Thorne
Town Clerk
Essex Town Hall
30 Martin Street
Essex, MA 01929

Re: Notice of Public Meeting on Ipswich Hazard Mitigation Plan

The Town of Ipswich is preparing its Hazard Mitigation Plan to reduce the town's vulnerability to natural hazard events such as flooding, hurricanes, and winter storms.

As part of the planning process, Ipswich's neighboring communities are being notified of a public meeting on the draft hazard mitigation plan to be hosted by the Ipswich Select Board:

Monday, December 3, 2018 at 7:20 PM
Ipswich Town Hall, Room A
25 Green Street
Ipswich, MA

The draft Hazard Mitigation Plan will include a set of hazard mitigation measures, such as infrastructure improvements, regulatory changes, and educational and outreach efforts related to mitigating natural hazards in the town of Ipswich.

A flyer announcing the meeting is attached. If you have any questions about this please feel free to contact me.

Best regards,

Martin Pillsbury
Environmental Planning Director
Metropolitan Area Planning Council
60 Temple Place
Boston, MA 02111
617.933.0747
mpillsbury@mapc.org

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# APPENDIX D
# DOCUMENTATION OF PLAN ADOPTION

To be completed following MEMA and FEMA review

**[Print on Town Letterhead]**

# CERTIFICATE OF ADOPTION
# SELECT BOARD
# TOWN OF IPSWICH, MASSACHUSETTS

A RESOLUTION ADOPTING THE
*TOWN OF IPSWICH HAZARD MITIGATION PLAN 2018 UPDATE*

WHEREAS, the Town of Ipswich established a Committee to prepare the *Town of Ipswich Hazard Mitigation Plan 2018 Update*; and

WHEREAS, the *Town of Ipswich Hazard Mitigation Plan 2018 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Ipswich, and

WHEREAS, duly-noticed public meetings were held by the IPSWICH PLANNING BOARD on March 29, 2018, and the IPSWICH SELECT BOARD on December 3, 2018, and

WHEREAS, the Town of Ipswich authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan,

NOW, THEREFORE BE IT RESOLVED that the Town of IPSWICH SELECT BOARD adopts the *Town of Ipswich Hazard Mitigation Plan 2018 Update*, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Ipswich.

ADOPTED AND SIGNED this Date. _____

Name(s)

Title(s)

Signature(s)

ATTEST

# APPENDIX E
# DOCUMENTATION OF PLAN APPROVAL

To be completed following FEMA review and approval of the plan